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The scientific publications of the National Museum include two series, known, respectively, as *Proceedings* and *Bulletin*.

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The present volume is the eightieth of this series.

The series of *Bulletins*, the first of which was issued in 1875, contains separate publications comprising monographs of large zoological groups and other general systematic treatises (occasionally in several volumes), faunal works, reports of expeditions, catalogues of type specimens and special collections, and other material of similar nature. The majority of the volumes are octavo in size, but a quarto size has been adopted in a few instances in which large plates were regarded as indispensable. In the *Bulletin* series appear volumes under the heading *Contributions from the United States National Herbarium*, in octavo form, published by the National Museum since 1902, which contain papers relating to the botanical collections of the Museum.

ALEXANDER WETMORE,

Assistant Secretary, Smithsonian Institution.

WASHINGTON, D. C., September 21, 1932.

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OBSERVATIONS ON THE GROWTH RATE OF THE FOOT IN THE MOUND BIRDS OF THE GENUS MEGAPODIUS

By HERBERT FRIEDMANN

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Among terrestrial birds the feet are generally relatively larger or more powerfully developed than in comparable arboreal forms, but there are few carinate birds with larger, more powerful feet than the megapodes. The unusual development of the feet in this group has been assumed to be correlated with their scratching habits, especially in making the mounds of decaying matter or in excavating the holes in the sand, as the case may be, in which they lay their eggs. Certainly few birds, even those that burrow in the ground, have more need of large, strong feet than the megapodes. In this family of birds, however, the case is somewhat different from that obtaining in other groups in that not only do the adults use their feet in digging, but the young have to dig their way up to the surface on hatching. In no other group of birds do the newly hatched young have such immediate need of strong feet. Consequently it seemed that a study of the feet of young and adult birds might show something of interest in helping to understand some fragment of the puzzles that the life histories of the megapodes present.

Recently the United States National Museum received a fine series of alcoholic specimens of *Megapodius pritchardi* collected by Lieut. Henry C. Kellers, United States Navy, on Niuaufou Island, one of the Tonga group. Among these there were two chicks and one embryo nearly ready to hatch, as well as a large number of adults of both sexes. The embryo is remarkable in that while it is in a stage of development close to hatching and has the pennaceous juvenal plumage well developed, although still encased in sheaths like the trichoptiles of cuculiform birds, it has no sign of an egg tooth. Incidentally, it seems that the extent of prehatching development in the megapodes is not generally appreciated. Whereas in most precocial birds, such as pheasants and ducks, the young are hatched fully covered with natal down, in the megapodes this plumage stage seems to be entirely telescoped into the period before hatching, and

the young birds when emerging from the egg are in the first penaceous, or juvenal, plumage. Pycraft¹ has noted this, but his paper has been largely overlooked by ornithologists.

The embryo has the following dimensions, in millimeters (the sizes of the culmen and wings are included as a scale by which to compare the embryo, the chicks, and the adults): Culmen, 11; wing, 74; tarsus, 28; first toe (without claw), 16; claw, 8; second toe, 16.5; claw, 8; third toe, 14.5; claw, 8; fourth toe, 11; claw, 7.5.

The two chicks are alike in their dimensions (millimeters): Culmen, 11; wing, 82; tarsus, 28; first toe, 16; claw, 8.5; second toe, 17; claw, 8.5; third toe, 15; claw, 8.5; fourth toe, 11; claw, 8.

Adults vary as follows (millimeters): Culmen, 22-26 (average, 24); wing, 178-192 (185); tarsus, 56-60 (58); first toe, 30; claw, 18; second toe, 31.5; claw, 19; third toe, 30; claw, 18; fourth toe, 23; claw, 18.5.

To summarize these data: The wing increases from 82 to 185 mm., an increase of approximately 126 per cent; the culmen grows from 11 to 24 mm., an increase of 118 per cent; the tarsus increases from 28 to 58 mm., a growth of 107 per cent; the first toe from 16 to 30 mm., an increase of 87.5 per cent; claw from 8 to 18 mm., an increase of 125 per cent; second toe from 16.5 to 31.5 mm., an increase of 91 per cent; claw from 8 to 19 mm., an increase of 137.5 per cent; third toe from 14.5 to 30 mm., an increase of 107 per cent; claw from 8 to 18 mm., an increase of 125 per cent; fourth toe from 11 to 23 mm., an increase of 109 per cent; claw from 7.5 to 18.5 mm., an increase of 147 per cent.

As a matter of comparison, chicks and adults of *Gallus sonnerati*, as an example of the pheasants, and of *Tinamus robustus*, as a representative of the tinamous (two fairly related groups), were examined, with the following results: In *Gallus sonnerati*, the culmen was found to increase by 56 per cent; the wings of the young chicks being unfortunately in poor condition, the wing growth could not be estimated; the tarsus increased by 114 per cent; the first toe by 26 per cent; the second toe by 37 per cent; the third toe by 32.5 per cent; the fourth toe by 13 per cent; the claws by 10 to 25 per cent. In *Tinamus robustus* again no wing data could be obtained; the culmen increased by 130 per cent; the tarsus by 129 per cent; the first toe by 95 per cent; the second toe by 85 per cent; the third toe by 85 per cent; the fourth toe by only 35 per cent. The claws increased by about 300 per cent.

On looking over these figures we may note that the megapodes show a much greater postnatal development of the claws than *Gallus* and much less than *Tinamus*; they show a greater growth of the toes

¹ Proc. Fourth Internat. Ornith. Congr., p. 458, 1907.

generally than does *Gallus* and slightly more than in *Tinamus*; they show less postnatal development of the tarsus than in either of the latter two. To put it another way: The young megapode, on hatching, has a rather unusually strong, well-developed tarsus, but not particularly large or heavily built toes or claws relative to its size as compared with adult birds. It has larger claws at all stages than do the pheasants or tinamous. The inference to be drawn from these few data (it is hoped they will be greatly extended by others with more abundant material) seems to be as follows: Adult megapodes are built for digging and excavating with their feet; young ones are not structurally adapted to digging themselves out except in having the tarsus unusually large. In other words, the digging is a matter of the tarsus in the young, while in the adults it seems to be more a matter of toes and claws. The mechanical advantage is greatly in favor of the adults.

This appears to be correlated with the difference in the sort of digging the young and old birds have to do. In digging down from the surface the old birds can scratch and shovel away the dirt, ash, or sand in all directions, and in such digging large, strong toes with big, heavy claws are of great service. The young birds, however, interred in the ash, sand, or mound, have to dig their way out; here the type of digging is more like an upward boring without the wide lateral spread possible in the adults' digging. For this type of work large toes with long, strong claws would be more of a hindrance than a help. The final conclusion to be drawn from the meager data available is that the premature development of the tarsus in the young bird up to the point of hatching is a feature that may readily be correlated with the peculiar breeding habits of the megapodes.

I have dissected the legs of young and old megapodes and find there is no difference in the arrangement or relative strength of the tendons and muscles working the toes.

The suggestion that the manner in which the young megapode digs itself out is like an upward boring is substantiated indirectly by Ashby's notes on the Australian megapode *Leipoa ocellata*.²

He writes of a newly hatched chick as follows:

It had hatched out and after being dried by the hot sand surrounding it, had scrambled up through the mound; by the mark where it had emerged the course taken was almost perpendicular.

Inasmuch as *Megapodius pritchardi* is confined to the small and seldom visited island of Niuafoou and has been collected only a few times, little has been recorded of it. It is one of the species that buries its eggs in the sand and volcanic ash and does not make large

² Auk, vol. 46, pp. 299, 300, 1929.

mounds of decaying matter. It would be of interest to make a comparative study of the growth of the appendages in species of both groups.

Recently Kellers³ has described his experiences with *Megapodius pritchardi* as follows:

The bird lays its egg in the ash hills of the 1886 eruption on the western side of the lake shore. It then buries the egg 1 to 2 meters deep in the ash and fills up the hole all the way to the surface. The temperature of the ash at the spot where the egg is laid is 98.1° F.; this heat is not connected with the heat of the volcano, but is rather a Dutch-oven effect. When the chick is hatched it scratches its way out of the ash and is ready to begin life's battles. I could not find any evidence of the male bird tending the young chicks, as is usual with this genus in Australia and the Philippines.

This agrees fairly well with what Friedländer⁴ notes, except that the latter author assumed the volcanic origin of the heat of the ash.

Finsch⁵ writes that the young of this megapode resembles the adults in color. This is not correct. The two chicks are much more yellowish-tawny below, and slightly buffier on the lower back and rump, than the old birds.

³ Explorations and field-work of the Smithsonian Institution in 1930, Smithsonian Publ. No. 8111, pp. 71-74, 1931.

⁴ Orn. Monatsb., vol. 7, pp. 37-40, 1899.

⁵ Proc. Zool. Soc. London, 1877, p. 784.

THREE NEW SPECIES OF POLYCHAETOUS ANNELIDS IN THE COLLECTIONS OF THE UNITED STATES NATIONAL MUSEUM

BY AARON L. TREADWELL

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In the course of the determination of annelids for the United States National Museum, three very interesting new species have come to hand. The first was collected by Dr. A. S. Pearse in Japan; the other two were obtained at Grande Isle, La., by William W. Anderson during a course in marine biology given at that place by Dr. Ellinor H. Behre, of the University of Louisiana, to whom we are indebted for the material.

NEREIS HETEROCIRRATA, new species

FIGURE 1

Two specimens, both lacking posterior ends, collected at Takami, near Chochi, Japan. The most noticeable feature is the peculiar development, relative to the other tentacular cirri, of the anterior ventral one. The two dorsal tentacular cirri extend about to the end of the palp, while the posterior ventral one is very much smaller. The anterior ventral one has an enlarged cirrophore and a much swollen, flask-shaped style, which does not quite reach the end of the basal joint of the palp. (Fig. 1, *a*.) In the preserved material the prostomium is a very little longer than the peristomium, and the tentacles are in contact at their bases. The eyes are large, those of the same side separated by a distance less than their diameter, the anterior pair no farther apart than the posterior. The peristomial width is 2 mm.; the length of the first 30 body somites 25 mm.

The first parapodium (fig. 1, *b*) has bluntly rounded, cylindrical dorsal and ventral lobes with a single setal lobe between them. The ventral and dorsal lobes are dark colored, as if they were glandular in structure. The setal lobe has a sharp-pointed posterior lip into which protrudes the apex of a single acicula. Dorsal and ventral to this acicula is a tuft of setae. The dorsal and the ventral cirri are about equal in length, about twice as long as the parapodial lobes. The ventral one is somewhat the heavier of the two and is attached nearer to the apex of the parapodium.

In the fifteenth parapodium the dorsal and ventral cirri are relatively much smaller and more slender, and the parapodial lobe is heavy and blunt pointed. (Fig. 1, *c*.) The dorsal lobe is now double and the seta tuft arises between the two parts. A single large acicula occurs in each part of the parapodium. In parapodia from the posterior part of the body the dorsal half of the upper parapodial lobe is, relatively to the others, much larger and bears the slender dorsal cirrus near its apex. The ventral cirrus is small and inconspicuous. (Fig. 1, *d*.) In the first parapodium the setae

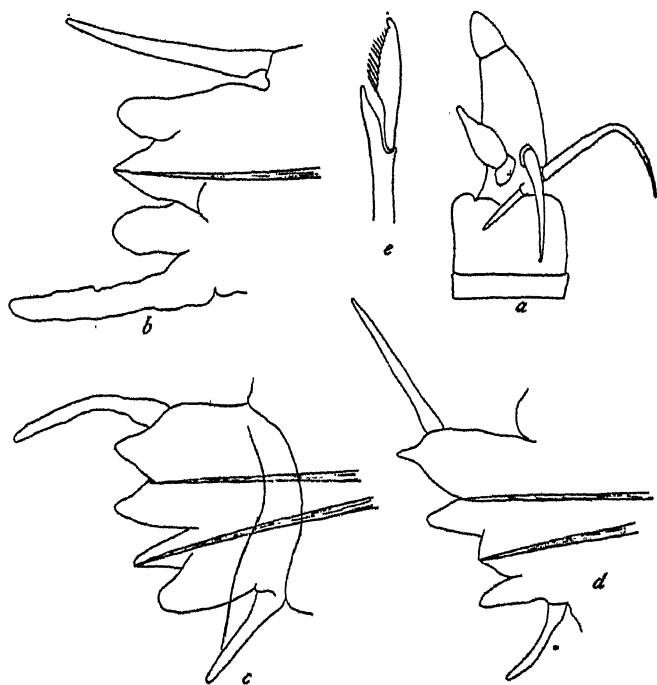


FIGURE 1.—*Nereis heterocirrata*, new species: *a*, Head, $\times 7.5$; *b*, first parapodium, $\times 18$; *c*, fifteenth parapodium, $\times 86$; *d*, posterior parapodium, $\times 27.5$; *e*, seta from first parapodium, $\times 250$

on the ventral part of the seta tuft have short terminal joints that carry long, heavy spines on the inner margins (fig. 1, *e*); those of the dorsal tuft have long and slender terminal joints, and these are finely toothed along one margin. In the posterior portions of the body the seta are badly broken, but so far as it is possible to tell both of the above varieties occur there. In addition are some with much more slender, noticeably "camerated" shafts, the terminal joints flat, elongated triangular in outline, with prominent marginal spines.

Type.—U.S.N.M. No. 19323.

LUMBRINEREIS ELONGATA, new species

FIGURE 2

In one bottle are a number of pieces of *Lumbrinereis*, one carrying the head and another the anal portion, and there are a number of other fragments. It is not possible to tell whether these all belong to the same individual, but they probably do, and in this case it is unusually long for this genus, measuring more than 300 mm. but with a body width of not more than 1 mm. No color appears in the preserved specimen. The prostomium (fig. 2, *a*) is sugar-loaf in outline, a trifle longer than wide, as long as the first three somites. There are two achaetous somites of which the first is a little longer than the second, the constriction between them being indistinct. Together they are about one-third longer than the third somite. The first parapodia are very short, but there is a gradual increase in length in later ones, full size being reached at about the fiftieth somite. Toward the posterior end there is a gradual decrease in the width of the somites but little change in the size of the parapodia. Three blunt, conical cirri and a fragment of a fourth are attached to the anal somite.

The parapodia have the form usual in this genus, with no notopodium and a prominent postsetal lobe. The two kinds of setae characteristic of *Lumbrinereis* are both present (fig. 2, *b*, *c*), the hooded form being much the more numerous. These have a large subapical tooth with a series of five or six apical ones beyond it. Of these the largest is near the subapical, and the others decrease in size toward the upper part, so that at the very end it is difficult to determine the exact number.

In the jaw (fig. 2, *d*) the forceps have a prominent carrier and a slender terminal portion. The left paired plate has a slender terminal tooth followed by three much heavier ones, and a basal hump that may be the remnant of a tooth. The second paired plate has two teeth, the terminal plate only one. The jaw was badly broken in removing and only the left side is intact, but so far as could be determined the plates are symmetrical on the two sides. All plates are dark brown. The mandible was too badly broken for description.

Holotype.—U.S.N.M. No. 19622, from Grande Isle, La.

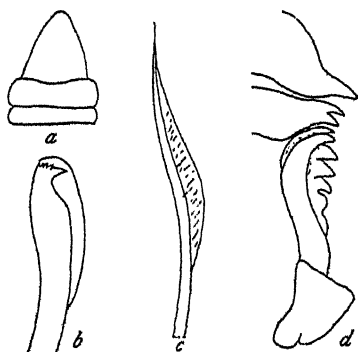


FIGURE 2.—*Lumbrinereis elongata*, new species: *a*, Head, $\times 10$; *b*, hooded seta, $\times 250$; *c*, simple seta, $\times 250$; *d*, part of jaw, $\times 45$

EUPOMATUS DECORUS, new species

FIGURE 3

An average-sized specimen has a length of 18 mm. from the collar margin to the end of the pygidium and a width at the collar margin of 1.5 mm. The branchial filaments are about 18 on a side, their length in a well-expanded specimen being 3 mm. The operculum and its stalk are large as compared with the filaments and extend considerably beyond them. In the 11 specimens in the collection, 5 have the operculum on the left side with a small and inconspicuous pseudoperculum on the right. In five others these relations are reversed, and in one there is a fully developed operculum on either side. The radioles are very short at the base of the branchia but soon become longer and at the end have a length four times the diameter of the branchia. There is a smooth tip, as long as the longest radiole, at the end of each branchia. The operculum stalk broadens into a funnel, which carries approximately 40 teeth on its margin. The terminal hooks on the operculum are 12 in number, long, slender, and gently curving to very sharp points.

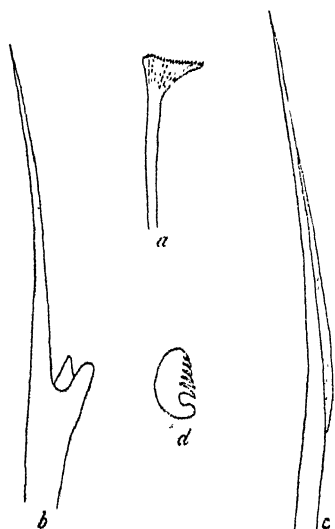


FIGURE 3. — *Eupomatus decorus*, new species: a, Dorsal abdominal seta, $\times 250$; b, stout seta from first bundle, $\times 165$; c, dorsal thoracic seta, $\times 250$; d, uncinus, $\times 250$

The branchia arise from a common base, which is about as high as the collar. The collar has four lobes, the dorsal ones at their dorsal ends overlapping the bases of the opercular stalks and separated from one another by a considerable space. A deep depression on each side separates the dorsal from the ventral lobe of the collar, the two latter ones overlapping on the ventral surface and extending farther over the bases of the gills than do the dorsal. The first seta tuft lies in the dorsal collar lobe.

In preserved material the general body color is pale straw, marked as follows with dark-brown pigment: A median stripe in each terminal tooth of the opercular margin; a narrow band on each side of the opercular spine, in some cases spread more diffusely over the base of the spine; a heavy band on the ventral surface, covering each torus of the last six thoracic somites; and a very much narrower band on the ventral margin of each abdominal somite, marking the region of the torus with a minute but still prominent spot at the location of the seta tuft.

At the dorsal end of the setal row in abdominal somites is a tuft of setae, as shown in Figure 3, *a*. Each has a heavy stalk, the inner end terminating bluntly, the outer end asymmetrically widened and concavo-convex in form, its margin denticulated. Fine lines extend down over the stalk from these denticulations. The first seta tuft (which lies in the dorsal collar lobe) contains two rows of setae with six or seven in a row. The first are slender, long, and sharp pointed and lie across the others at an angle of about 45° . The basal part of the second kind is much heavier, having four or five times the diameter of the slender ones. Near the apex their stalk divides into three spines, one of which is long, slender, and sharp-pointed, the other two short and conical. (Fig. 3, *b*.) In the rest of the thoracic somites the dorsal setae are moderately stout, curved, and sharp-pointed and have a fin along the convex margin. (Fig. 3, *c*.) The uncini are similar throughout the body, each (fig. 3, *d*) having a rounded base and six teeth, which decrease gradually in size from the basal to the terminal of the series.

A fragment of the limestone tube remains attached to the holotype. This is heavy and has marked longitudinal ridges.

Holotype.—U.S.N.M. No. 19621, collected at Grand Isle, La.

RECENT FORAMINIFERA FROM THE ATLANTIC COAST OF SOUTH AMERICA

By JOSEPH A. CUSHMAN and FRANCES L. PARKER

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This is the third of a series of papers on the recent foraminifera from the collections made by Dr. Waldo L. Schmitt, of the United States National Museum, on his trip about South America under the auspices of the Walter Rathbone Bacon scholarship of the Smithsonian Institution. Those from Juan Fernandez have already been studied and the results published,¹ as well as those from the west coast of South America.²

D'Orbigny's memoir on the foraminifera of his voyage around South America, published in 1839, contained figures and descriptions of many new species that have not been recorded or referred to since that date. Very little has been added to the knowledge of the foraminiferal fauna of the South American coast, including the Falkland Islands. The *Challenger* occupied a few stations along the eastern coast of South America, but mostly in the offshore waters. The paper by Brady, Parker, and Jones on the foraminifera of the Abrohlos Bank, together with the records given by Pearcey, furnished most of the few additional records from the region. Flint studied a very few of the *Albatross* collections made on the trip around South America, and Heron-Allen and Earland are now publishing papers on the fauna of the Falkland Islands collected by the *Discovery* Expedition.

The relations of the fauna are interesting. Our stations from off Brazil, especially the harbor of Rio de Janeiro, show that the fauna at that point is essentially a West Indian one, and most of the species are to be found in d'Orbigny's work of 1839 on the West Indies, or in more recent works on the fauna of the same region. The stations to the south along the coast of Argentina and the shallow water of the Falklands give a cold-water fauna, which is not closely

¹ Cushman and Wickenden, Proc. U. S. Nat. Mus., vol. 75, art. 9, 1929.

² Cushman and Kellett, Proc. U. S. Nat. Mus., vol. 75, art. 25, 1929.

related to that of Brazil, but which has numerous species recorded by d'Orbigny in 1839 from this same region, and others evidently extending around Cape Horn. These are identical with species described by d'Orbigny from the west coast. The faunas of the two sides of South America are, however, for the most part quite different.

In order to avoid repetition, reference is given to the various parts of United States National Museum Bulletin 104 on the Atlantic foraminifera, where complete description and synonymy of the various species will be found. Nearly all the species are already known from earlier works, but three of the forms are here described as new. In order that workers may have a visual record of the forms of this region, nearly all the species are illustrated. Most of those not figured here, such as the species of *Elphidium*, are already figured in Bulletin 104, some of them from this same material. The figures are from drawings made by Miss Margaret S. Moore. The data for the stations represented are as follows:

- Station 1. Ilha Paqueta, Rio de Janeiro Harbor, Brazil, August 17, 1925; tidal flats.
2. Nictheroy, Rio de Janeiro Harbor, Brazil, August 22, 1925.
8. Off Ilha Govenador, Rio de Janeiro Harbor, Brazil, August 2, 1925; boat dredge, 3 fathoms, muddy, shelly bottom.
80. Port Stanley, Falklands, February 23, 1927; boat dredge, 1 to 2 fathoms, mud and broken shell bottom.
85. Below Port Darwin, Choisel Sound, Falklands, March 2, 1927; bottom sampler, 4 fathoms.
87. Off lower jetty, Port Howard, Falklands, March 4, 1927; bottom sampler, 4 fathoms.
95. Narrows between Port Stanley and Port William, Falklands, March 20, 1927; bottom sampler, 3 to 4 fathoms, sandy bottom.
97. Port William, Falklands, March 20, 1927; oyster dredge, 8 to 10 fathoms, weedy bottom.
105. Off light, north shore Port William, Falklands, April 9, 1927, oyster dredge, 14 to 15 fathoms, weedy, shelly bottom.
123. Anchorage, St. Julian, Argentina, May 6, 1927; bottom sampler.
124. Anchorage, Puerto Deseado, Argentina, May 7, 1927; bottom sampler.

Family SACCAMMINIDAE

Genus *PROTEONINA* Williamson, 1858

PROTEONINA DIFFLUGIFORMIS (H. B. Brady)

PLATE 1, FIGURE 1

Proteonina diffugiformis CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 1, p. 48, 1918.

The specimens of this species are very common at station 85 only, in 4 fathoms, Choisel Sound, Falklands. They are typical, however, and one of them is here figured.

Family AMMODISCIDAE

Genus GLOMOSPIRA Rzehak, 1888

GLOMOSPIRA GORDIALIS (Jones and Parker)

PLATE 1, FIGURE 2

Glomospira gordialis CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 1, p. 99, 1918.

This species is common only about the Falkland Islands in our material and was not found at any of the stations along the eastern coast of South America. It is subject to the usual variations, especially in the plane of coiling of the chambers.

Genus TOLYPAMMINA Rhumbler, 1895

TOLYPAMMINA VAGANS (H. B. Brady)

PLATE 1, FIGURE 3

Tolypammina vagans CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 1, p. 91, 1918.

There are a few specimens in the shallow water from the Falkland region, but the species does not occur at any of the stations to the north.

Family LITUOLIDAE

Genus HAPLOPHRAGMOIDES Cushman, 1910

HAPLOPHRAGMOIDES CANARIENSIS (d'Orbigny)

PLATE 1, FIGURES 4 a, b

Haplophragmoides canariensis CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 2, p. 38, 1920.

At some of the stations about the Falklands this species is very common and seems to be typical of the species as figured by d'Orbigny. It is much closer to his type figures than are many of the later figures given by other authors and referred to his species.

Family MILIOLIDAE

Genus QUINQUELOCULINA d'Orbigny, 1826

QUINQUELOCULINA FUSCA H. B. Brady

PLATE 1, FIGURES 9 a-c

Quinqueloculina fusca CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 6, p. 23, 1929.

It might be supposed that this arenaceous species would be most abundant in the cold water toward the south, but the only specimens of arenaceous Miliolidae found belong to this species, which occurs only at station 1, in Rio de Janeiro Harbor. None of the other arenaceous species so common in the West Indian region occurs here, so far as our material shows.

QUINQUELOCULINA CANDEIANA d'Orbigny

PLATE 1, FIGURES 10 a-c

Quinqueloculina candeiana CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 6, p. 27, 1929.

The only previous records for this species are those by d'Orbigny, from the West Indian region, and later from the Tortugas and Porto Rico. It is not surprising, therefore, to find the species in its typical form at stations 1 and 2 in Rio de Janeiro Harbor.

QUINQUELOCULINA LAMARCKIANA d'Orbigny

PLATE 1, FIGURES 7 a-c

Quinqueloculina lamarckiana CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 6, p. 26, 1929.

This species was found only at stations 1 and 8. It is common in the West Indian region but is also widely distributed elsewhere. Our specimens fit d'Orbigny's species, and it is apparent that his *Quinqueloculina magellanica* is also a synonym of this species, probably representing a southward expansion of it into colder water.

QUINQUELOCULINA ISABELLEI d'Orbigny

PLATE 1, FIGURES 11 a-c; PLATE 2, FIGURES 2 a-c

Quinqueloculina isabellei D'ORBIGNY, Voyage dans l'Amérique Méridionale, vol. 5, pt. 5, "Foraminifères," p. 74, pl. 4, figs. 17-19, 1839.

Test about twice as long as broad but compressed, in end view the lateral chambers projecting only slightly beyond the two outer chambers, which are more or less in one plane; chambers distinct, inflated; sutures distinct, depressed; wall smooth and glossy; aperture large, with a slight lip and a very large tooth, which in side view projects well above the outline of the chamber and in end view nearly fills the opening.

D'Orbigny's original material of this species was from the coast of Patagonia. It occurs very well developed in the region of the Falklands and also along the Argentine (Patagonian) coast. There are much smaller specimens, which may possibly be variants of this species, from the stations off the coast of Brazil, but the species is only well developed in the colder waters to the south. The peculiar ivory-white color, the glossy surface, and the contour of the chambers will distinguish this species, which is apparently localized about the southern coast of South America.

QUINQUELOCULINA LAEVIGATA d'Orbigny

PLATE 1, FIGURES 5, 6

Quinqueloculina laevigata CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 6, p. 30, 1929.

There are numerous specimens from the stations along the Brazilian coast that are referable to this species, which is a typically West Indian one.

QUINQUELOCULINA COSTATA d'Orbigny

PLATE 1, FIGURES 8 a-c

Quinqueloculina costata CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 6, p. 31, 1929.

As might be expected, this species, which is a common West Indian one, occurs only in our material from Rio de Janeiro Harbor, and there it is rather rare.

Genus TRILOCULINA d'Orbigny, 1826

TRILOCULINA CIRCULARIS Bornemann

PLATE 1, FIGURES 12 a-c

Triloculina circularis CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 6, p. 53, 1929.

This species, which is very widely distributed, occurs in considerable numbers at the stations off the Falklands and northward along the coast of Rio de Janeiro Harbor.

Genus PYRGO Defrance, 1824

PYRGO SUBSPHAERICA (d'Orbigny)

PLATE 1, FIGURES 13 a, b

Pyrgo subsphaerica CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 6, p. 63, 1929.

This species, which is so abundant in shallow water in the West Indian region, appears to be very rare along the coast of South America. There are specimens from Rio de Janeiro Harbor, which may possibly be assigned to it, and also from station 8.

Family OPTHALMIDIIDAE

Genus CORNUSPIRA Schultze, 1854

CORNUSPIRA INVOLVENS Reuss

PLATE 2, FIGURE 1

Cornuspira involvens CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 6, p. 80, 1929.

A large proportion of our stations have this species present in few numbers. The only one at which it could be considered common is station 105, Port William, Falklands.

Genus *PLANISPIRINA* Seguenza, 1880*PLANISPIRINA AURICULATA* Egger

PLATE 2, FIGURE 3

Planispirina auriculata CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 6, p. 93, 1920.

There is a single specimen, which is like those found in the West Indian region and also in the Indo-Pacific, from station 8. This extends the western-Atlantic range of the species from the region of Beaufort, S. C., on the north, to this station on the south. It is never found apparently in any great numbers in the Atlantic, and its small size also makes it rather easily overlooked.

Family TROCHAMMINIDAE

Genus *TROCHAMMINA* Parker and Jones, 1860*TROCHAMMINA GLOBIGERINIFORMIS* (Parker and Jones)

PLATE 2, FIGURES 4 a-c

Trochammina globigeriniformis CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 2, p. 78, 1920.

There are numerous specimens that may be referred to this species, but, like the figured one, they are mostly compressed, and while the chambers themselves are more or less globular, the entire test does not have the high spire often characteristic of the species. The figured specimen is from off St. Julian, Argentina, and we have other specimens from the northward at stations 8 and 2.

TROCHAMMINA ROTALIFORMIS J. Wright

PLATE 2, FIGURES 5 a-c

Trochammina rotaliformis CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 2, p. 77, 1920.

A few specimens similar to that here figured, composed of several coils with four or five chambers in each, are referred to this species. They are from off the Falkland Islands.

TROCHAMMINA PERUVIANA Cushman and Kellett

PLATE 2, FIGURES 7 a-c

Trochammina peruviana CUSHMAN and KELLETT, Proc. U. S. Nat. Mus., vol. 75, art. 25, p. 4, pl. 1, figs. 8a, b, 1929.

Test trochoid, spire greatly flattened, dorsally very slightly convex, ventrally slightly concave, consisting of three or four whorls; chambers numerous, 10 or more in the last-formed whorl, of rather uniform size and shape, increasing slowly in size as added; sutures on

the dorsal side gently curved, very slightly depressed, only those of the last-formed whorl distinct, on the ventral side gently curved or with a sinuous, lobed condition, especially in later portions, distinct; wall finely arenaceous with much chitin, thin, very flexible when wet; aperture ventral, along the margin of the last-formed chamber.

The above description, which is copied from the original, applies equally well to our specimens from station 2, off Ilha Paqueta, Rio de Janeiro Harbor. The peculiar sinuous arrangement of the ventral side is perhaps not quite so marked as in the types from off Peru, but otherwise the specimens agree very well with the types.

Family LAGENIDAE

Genus NODOSARIA Lamarck, 1812

NODOSARIA CALOMORPHA Reuss(?)

PLATE 3, FIGURES 1, 2

Nodosaria calomorpha REUSS, Denkschr. k. Akad. Wiss. Wien, vol. 25, p. 129, pl. 1, figs. 15-19, 1885.

At numerous stations from station 8 southward to the Falklands there occur numerous fragmentary specimens, never consisting of more than three chambers, which may be referred with some question to this species of Reuss. The chambers, as shown in the figured ones, are somewhat longer than broad; and the sides are broadest in the middle. The one with three chambers shows that it comes from a specimen that had at least two other chambers, and it is probable that this does not represent very closely Reuss's species from the Tertiary of Europe, but it is not sufficiently complete for full description. Our specimens are exactly identical with those figured by Brady in the *Challenger* report under this name.

NODOSARIA CATESBYI d'Orbigny

PLATE 3, FIGURES 3, 4

Nodosaria catesbyi D'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," p. 16, pl. 1, figs. 8-10, 1839.—CUSHMAN, Florida State Geol. Surv. Bull. 4, p. 28, pl. 5, fig. 4, 1930.

Nodosaria sp. (?) CUSHMAN, Carnegie Inst. Washington Publ. 311, p. 32, pl. 4, fig. 2, 1922.

Test composed of two chambers, the proloculum subglobular, with a short basal spine, the second chamber more pyriform, apertural end somewhat prolonged; suture distinct and depressed; wall ornamented with numerous, very distinct costae, which extend the entire length of the two chambers to the aperture.

This species, described by d'Orbigny from the West Indian region, has been found to be common in that area, and also is found in the Miocene of Florida. In the present collections it occurred in considerable numbers at station 8 but was not seen elsewhere.

Genus *LAGENA* Walker and Jacob, 1798

LAGENA ASPERA Reuss

PLATE 3, FIGURE 7

Lagena aspera CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 4, p. 8, 1923.

This species is rare at station 97, Port William, Falklands.

LAGENA CAUDATA (d'Orbigny)

PLATE 3, FIGURE 9

Oolina caudata D'ORBIGNY, Voyage dans l'Amérique Méridionale, vol. 5, pt. 5, "Foraminifères," p. 19, pl. 5, fig. 6, 1839.

Lagena caudata REUSS, Sitz. k. Akad. Wiss. Wien, vol. 46, pt. 1, p. 325, pl. 6, fig. 29, 1862.

D'Orbigny's original specimens came from the Falkland Islands and the coast of Patagonia. His figure shows a pyriform specimen with numerous costae and with the base ending in a definite spine. Our figured specimen, which is from station 8 off the South American coast, resembles d'Orbigny's in the longitudinal costae and the basal spine, but the shape of the test is quite different. This is the only material in the collection that at all approaches this species.

LAGENA PERLUCIDA (Montagu)

PLATE 3, FIGURE 6

Lagena perlucida CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 4, p. 46, 1923.

This is by far the commonest species of the genus in the present collections, occurring in considerable numbers at Port Stanley, Falklands, and as scattered specimens at other stations in that region, as well as stations 8 and 2 to the northward. As usual there is considerable variation in the shape and costae in this species.

LAGENA LYELLI (Seguenza)

PLATE 3, FIGURE 8

Lagena lyelli CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 4, p. 34, 1923.

At station 8 there are numerous specimens of the form here figured that may be referred to Seguenza's species. There is a slight basal

spine. The main body of the test is globular, and there are a few faint, longitudinal costae.

LAGENA VILARDEBOANA (d'Orbigny)

PLATE 3, FIGURE 5

Oolina vilardeboana D'ORBIGNY, Voyage dans l'Amérique Méridionale, vol. 5, pt. 5, "Foraminifères," p. 19, pl. 5, figs. 4, 5, 1839.

Lagena vilardeboana REUSS, Sitz. k. Akad. Wiss. Wien, vol. 46, pt. 1, p. 329, pl. 4, fig. 53, 1862.

The types of this species were described by d'Orbigny from the Falkland Islands. His figures show a single chamber with very strong, longitudinal costae, very similar to those in our figure. These costae are blunt as shown in his partial section. In our specimens there seem to be distinct and rather coarse perforations between the costae. These are referred to d'Orbigny's species and are from the Falklands at Port William.

LAGENA MELO (d'Orbigny)

Lagena melo CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 4, p. 38, 1923.

D'Orbigny originally described this species from the Falkland Islands, and we have specimens both from the Falklands from Port William, and from station 123, St. Julian, Argentina, which are exactly like the figured specimens given by d'Orbigny. Most of the figured forms referred to this species are not typical, and many of them seem best referred to Williamson's species, which he figured from off the British Isles. It may be possible that the typical *Lagena melo* is only to be found in the vicinity of the Falklands and the southern part of South America.

Family POLYMORPHINIDAE

Genus GUTTULINA d'Orbigny, 1826

GUTTULINA LACTEA (Walker and Jacob)

PLATE 3, FIGURES 10, 11

Guttulina lactea CUSHMAN and OZAWA, Proc. U. S. Nat. Mus., vol. 77, art. 6, p. 43, 1930.

There are a few specimens from Rio de Janeiro Harbor, adult and young of which are figured here. These seem to correspond closely with the typical form of the species, which is widely distributed in the present oceans.

Family NONIONIDAE

Genus NONION Montfort, 1808

NONION GRATELOUPI (d'Orbigny)

PLATE 2, FIGURES 6 a, b

Nonion grateloupi CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 7, p. 10, 1930.

There are numerous specimens of this West Indian species from the three stations in Rio de Janeiro Harbor, but it has not occurred in any of the material from the region to the south.

Genus ELPHIDIUM Montfort, 1808

ELPHIDIUM POEYANUM (d'Orbigny)

Elphidium poeyanum CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 7, p. 25, 1930.

This species is the most abundant one in the West Indian region, and it is therefore not surprising to find that it is common at all three of the stations in Rio de Janeiro Harbor. These specimens are typical and show the very prominently perforate wall and the short retral processes. It seems to be replaced in the colder water to the south by the following species.

ELPHIDIUM ARTICULATUM (d'Orbigny)

Elphidium articulatum CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 7, p. 26, 1930.

D'Orbigny described this species from "the coast of Patagonia, near Rio Negro, and also from the Falklands." It is fairly common off the Falklands in shallow water and also occurs off St. Julian, Argentina, and off Puerto Deseado, Argentina. These stations correspond exactly with the distribution of the species as given by d'Orbigny. This may be distinguished from *E. poeyanum* by the highly polished and very finely perforate wall, the perforations being so small that the wall appears entirely clear in many specimens.

ELPHIDIUM INCERTUM (Williamson)

Elphidium incertum CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 7, p. 18, 1930.

A very few specimens in the collections from South America may be referred to Williamson's species. They are not typical, however, and possibly may have to be referred elsewhere.

ELPHIDIUM SAGRUM (d'Orbigny)

Elphidium sagrum CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 7, p. 24, 1930.

The only specimen that can be referred to this West Indian species is a single one from Rio de Janeiro Harbor. This specimen is typical,

however, in its general form and in the heavy, somewhat costate, appearance of the early part of the last-formed coil. So far as the examination of West Indian material shows, this species is never an abundant one, but is nevertheless widely distributed in this warmer area of the western Atlantic.

ELPHIDIUM LESSONII (d'Orbigny)

Elphidium lessonii CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 7, p. 22, 1930.

This is one of the finest species of the genus, very abundant and well developed in the general region of the Falklands, occurring at Port William, Port Stanley, and Port Howard. There are also typical specimens from Puerto Deseado, Argentina. D'Orbigny's original type locality is given as the "coast of Patagonia, to the south of Rio Negro." His type specimen was not apparently a completely adult form, but represents a young stage frequently seen with the others in our collections. In the adult form this is a very beautifully sculptured species and can hardly be confused with any other one of the genus. So far as is known it is limited to the general region of the Falklands and southern South America. It may be noted that Brady's figure in the *Challenger* report (pl. 110, fig. 9) is probably this species. This particular figured specimen was from the Falklands.

ELPHIDIUM OWENIANUM (d'Orbigny)

Elphidium owenianum CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 7, p. 21, 1930.

D'Orbigny described this species from off the "coast of Patagonia, to the south of Rio Negro." It may be distinguished from the others of the region by the thickening of the umbilical region, very distinct sutures, and the subacute margin. We have specimens from the Falklands at Port Howard and Port William, and it also occurs off Puerto Deseado, Argentina. It is not nearly so common as the preceding species.

ELPHIDIUM cf. ADVENUM (Cushman)

Elphidium cf. *advenum* CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 7, p. 25, 1930.

The only specimens that can be referred to this species occur in the warm water of Rio de Janeiro Harbor. This species is typically a warm-water one of the West Indies and occurs also as far back as the Miocene of the Florida region. Some of the specimens of the following species somewhat resemble this, but the umbonal portion of *E. advenum* is very distinct, with a definite boss in its typical form, whereas the central region of *E. alvareziannum* is excavated and without any central boss.

ELPHIDIUM ALVAREZIANUM (d'Orbigny)

Elphidium alvarezianum, CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 7, p. 18, 1930.

This is one of the distinctive species of the Falklands and southern South America, recorded from both regions by d'Orbigny in his original description. Besides the typical form the following variety occurs in the region of the Falklands:

ELPHIDIUM ALVAREZIANUM (d'Orbigny) SERRULATUM, new variety**PLATE 2, FIGURES 9 a, b**

Variety differing from the typical in the character of the periphery, which has definite toothlike projections, in the extreme form having each projection opposite the chambers divided into numerous serrations. Specimens connecting this variety with the typical form occur in which the spinose projections are simple.

Holotype of variety (U.S.N.M. No. 21932) from station 97, Port William, Falkland Islands, collected by Dr. Waldo L. Schmitt.

In its fully developed form this is a very beautiful variety and unlike any other form known to us. It is, however, very definitely related to d'Orbigny's species.

ELPHIDIUM AUSTRALIS, new species**PLATE 2, FIGURES 8 a, b**

Test planispiral, nearly completely involute, the periphery very broadly rounded, and in the last-formed portion almost truncate; chambers very distinct, 12 to 15 in the last-formed coil, of nearly uniform shape and increasing only slightly in size as added; sutures deep, very distinct; retral processes very short and often inconspicuous; wall of the main body of the chamber smooth except in the early portion of the last-formed coil, where it is often roughened by small papillae arranged more or less in longitudinal lines in the plane of coiling, unbonal region also strongly papillate; aperture consisting of numerous small circular pores at the base of the apertural face, which is smooth, with a distinct border about its periphery. Diameter, 0.5-0.6 mm.; thickness, 0.25 mm.

Holotype (U.S.N.M. No. 21933) from station 80, Port Stanley, Falkland Islands, collected by Dr. Waldo L. Schmitt.

This species was common at the type station but did not occur at any of the other stations in the entire collection. It is a very distinct and unmistakable species and apparently of very limited distribution.

Family BULIMINIDAE

Genus BULIMINELLA Cushman, 1911

BULIMINELLA ELEGANTISSIMA (d'Orbigny)

PLATE 3, FIGURES 12, 13

- Bulimina elegantissima* D'ORBIGNY, Voyage dans l'Amérique Méridionale, vol. 5, no. 5, "Foraminifères," p. 51, pl. 7, figs. 13, 14, 1839.—SCHLUMBERGER, Feuille Jeun. Nat., vol. 12, p. 8, pl. 1, fig. 14, 1882.—H. B. BRADY, Rep. Voy. Challenger, Zoology, vol. 9, p. 402, pl. 50, figs. 20-22, 1884.—SIDEBOTTOM, Mem. Proc. Manchester Lit. Philos. Soc., vol. 49, no. 5, p. 11, pl. 2, fig. 6, 1905.
- Buliminella elegantissima* CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 2, p. 89, 1911; Proc. U. S. Nat. Mus., vol. 56, p. 606, 1919; Contr. Cushman Lab. Foram. Res., vol. 1, pt. 2, p. 40, pl. 6, figs. 5 a, b, 1925.—CUSHMAN and KELLETT, Proc. U. S. Nat. Mus., vol. 75, art. 25, p. 6, pl. 3, figs. 1-3, 1929.—CUSHMAN, Florida State Geol. Surv. Bull. 4, p. 42, pl. 8, figs. 2, 3, 1930.

Test elongate, spiral, making about three volutions, initial end pointed, much more so in the microspheric form; chambers numerous, 7 to 10 in the last-formed whorl, narrow, slightly inflated; sutures distinct, slightly curved, very slightly depressed; wall smooth, finely perforate; aperture elongate, narrow, somewhat enlarged toward the middle of the apertural face.

This has proved to be one of the most abundant species in the collection, originally described from the west coast of South America, where it is also very abundant. Its range includes the Falklands and the coast of South America northward as far as our material covers, to Rio de Janeiro Harbor, where it also occurs in typical form. Its fossil range goes back at least to the Miocene of Florida, where it is extremely common in the Choctawhatchee marl at numerous localities. Many other things have been included by various authors in this species, but in its typical form it does not seem to show any great degree of variation.

BULIMINELLA PARALLELA, new species

PLATE 3, FIGURES 15 a-c

Test elongate, the sides usually nearly parallel for most of their length, both ends broadly rounded, nearly circular in transverse section; chambers distinct, in three or more whorls, the spiral suture being somewhat irregularly crenulate, several chambers, five or more, in each whorl, not much if at all inflated; sutures distinct, slightly limbate, flush with the surface; wall smooth and polished, very finely perforate; aperture rounded with very slightly raised costae running in toward it on the surrounding depressed area. Length, 0.25 mm.; breadth, 0.08-0.1 mm.

Holotype (U.S.N.M. No. 21934) from station 2 off Ilha Paqueta, Rio de Janeiro Harbor, collected by Dr. Waldo L. Schmitt.

This species has been referred to *B. elegantissima* by some authors and is closely related to the form described by Millett from the Malay Archipelago, as *B. elegantissima* var. *compressa*. The form that Millett assigns to *B. elegantissima* is also very close to our species.

Genus BULIMINA d'Orbigny, 1826

BULIMINA PATAGONICA d'Orbigny

PLATE 3, FIGURE 14

Bulimina patagonica D'ORBIGNY, Voyage dans l'Amérique Méridionale, vol. 5, pt. 5, "Foraminifères," p. 50, pl. 1, figs. 8, 9, 1839.—CUSHMAN and WICKENDEN, Proc. U. S. Nat. Mus., vol. 75, p. 8, pl. 3, figs. 11 *a*, *b*, 1929.—CUSHMAN and KELLETT, Proc. U. S. Nat. Mus., vol. 75, art. 25, p. 7, pl. 3, figs. 4 *a*, *b*, 1929.

There are a very few specimens that seem to be the same as that described by d'Orbigny and that have been recorded in the above references from the west coast of South America. The specimens we have, one of which is here figured, show the irregularity of the last-formed chambers, very similar to the type specimen figured by d'Orbigny. This seems to be a characteristic feature of the species.

BULIMINA MARGINATA d'Orbigny

Bulimina marginata CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 3, p. 91, 1922.

There are a few specimens, all from the three stations in Rio de Janeiro Harbor, that seem best referred to this species. They have the small teeth along the margin definitely at the margin and not above it, as in d'Orbigny's *B. pulchella*.

Genus ENTOSOLENIA Ehrenberg, 1848

ENTOSOLENIA COMPRESSA (d'Orbigny)

PLATE 3, FIGURE 16

Oolina compressa D'ORBIGNY, Voyage dans l'Amérique Méridionale, vol. 5, pt. 5, "Foraminifères," p. 19, pl. 5, figs. 1, 2, 1839.

Under this specific name d'Orbigny described a compressed *Lagena*-like form from the Falklands and the coast of Patagonia. He noted that it is very rare. We have a very similar form, in which the periphery has a blunt, thickened keel and there is a definite internal tube, placing this species in *Entosolenia*. Our specimens were from the Falklands at Port Howard and Port William.

ENTOSOLENIA IOTA (Cushman) (?)

PLATE 3, FIGURE 17

Entosolenia iota CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 4, p. 27, 1923.

A very few specimens from the Falklands have a peculiar curved thickness resembling very much the species described under this specific name from the North Atlantic. The shape, however, is not exactly the same, and it may be found not to be this species when further material is available.

ENTOSOLENIA sp. (?)

PLATE 3, FIGURE 18

A figure is given showing the peculiar small species with an internal tube, which has a very broad aperture with a decided short neck and phialine lip. It is figured here for future reference.

Genus VIRGULINA d'Orbigny, 1826

VIRGULINA PUNCTATA d'Orbigny

Virgulina punctata CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 3, p. 117, 1922.

Very rare specimens, which are identical with this species so common in the general West Indian region, occur at all three of the stations in Rio de Janeiro Harbor.

There are single specimens from three stations off the Falklands which represent species belonging to this genus, but they are evidently the young stages, and therefore are not specifically determinable.

Genus BOLIVINA d'Orbigny, 1839

BOLIVINA PULCHELLA (d'Orbigny)

PLATE 3, FIGURE 20

Bolivina pulchella CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 3, p. 41, 1922.

There are a few very typical specimens of this species from two of the stations in Rio de Janeiro Harbor. This is, however, a typically West Indian species confined to this region of the western Atlantic.

BOLIVINA PLICATELLA Cushman

PLATE 3, FIGURE 19

Bolivina plicatella CUSHMAN, Florida State Geol. Surv. Bull. 4, p. 46, pl. 8, figs. 10 a, b, 1930.

Test small, short and broad, compressed, greatest width near the apertural end, periphery subacute; chambers, except the last two, obscured by the ornamentation, which also obscures the sutures; wall

ornamented by two distinct longitudinal ridges, rounded or sharp, connected between with transverse ridges, coinciding partially with the chambers, leaving the whole surface broken into series of irregular depressions, coarsely perforate; aperture elongate.

This species, recently described from the Miocene of the Choctawhatchee marl of Florida, occurs also living in the West Indian region, and specimens occur as far south as the Falklands, including Rio de Janeiro Harbor and the coast of Argentina.

Heron-Allen and Earland have given a new name to a closely related form that occurs off the coast of Europe. Both of these species have been for a long time classed with d'Orbigny's *B. plicata*, which is a very different species occurring off the western coasts of North and South America.

BOLIVINA STRIATULA Cushman

PLATE 3, FIGURES 21 a, b

Bolivina striatula CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 3, p. 43, 1922.

Like many others of the typical West Indian species, this one occurs in considerable numbers at all three stations in Rio de Janeiro Harbor, but nowhere else in the collections to the southward. Specimens are well developed and typical.

BOLIVINA TORTUOSA H. B. Brady

PLATE 3, FIGURES 22 a, b

Bolivina tortuosa CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 3, p. 49, 1922.

There are two specimens of this species from one of the stations in Rio de Janeiro Harbor. Neither of these is apparently an adult specimen, but they resemble the Atlantic form of the species much more than the Pacific one.

BOLIVINA sp.(?)

PLATE 3, FIGURES 23 a, b

The figured specimen shows a peculiar small species, which occurred rarely in the material from Rio de Janeiro Harbor, and without a larger series it can not be definitely assigned a specific name.

Genus LOXOSTOMUM Ehrenberg, 1854

LOXOSTOMUM MAYORI (Cushman)

PLATE 3, FIGURE 24

Bolivina mayori CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 3, p. 40, 1922.

Very excellent and typical specimens of this species occur in considerable numbers in the collection from Rio de Janeiro Harbor.

It is a characteristic West Indian species, and some of the Brazilian specimens reach a size nearly as great as that of those specimens found off the Tortugas, Fla., the type locality. The last chambers have the aperture terminal and show a tendency toward becoming uniserial, characters that place this species in the genus *Loxostomum*.

Genus SIPHOGENERINA Schlumberger, 1883

SIPHOGENERINA cf. RAPHANUS (Parker and Jones)

PLATE 3, FIGURES 25, 26

Siphogenerina cf. raphanus CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 4, p. 174, 1923.

The Atlantic material of this species is never so well developed as is that form found in the Indo-Pacific. Forms assigned to this species occur rarely in the West Indian region, and there are a few specimens from all three of the stations in Rio de Janeiro Harbor. The aperture is always large, and there is no definite neck produced as in the Indo-Pacific form. The costae are limited to the early portion of the test as a rule and are not so well developed as in the typical form.

Genus ANGULOGERINA Cushman, 1927

ANGULOGERINA OCCIDENTALIS (Cushman)

Uvigerina angulosa CUSHMAN (not Williamson), Carnegie Inst. Washington Publ. 311, p. 34, pl. 5, figs. 3, 4, 1922.

Uvigerina occidentalis CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 4, p. 169, 1923.

Angulogerina occidentalis (CUSHMAN), Florida State Geol. Surv. Bull. 4, p. 50, pl. 9, figs. 8, 9, 1930.

Test minute, elongate, triangular in transverse section, the periphery somewhat lobulate; chambers distinct, those of the last-formed portion becoming more distinct and remote; sutures distinct and depressed; wall ornamented with longitudinal costae on all but the last-formed chambers in the adult; apertural end drawn out into a short tubular neck and slight phialine lip.

This species is known from the Miocene of the Florida region, and also is living in the general West Indian area. Our material shows it to be present at all three of the stations in Rio de Janeiro Harbor, but its range does not extend to the collections made to the southward.

Family ROTALIIDAE

Genus SPIRILLINA Ehrenberg, 1841

SPIRILLINA VIVIPARA Ehrenberg var. DENSEPUNCTATA Cushman

PLATE 4, FIGURES 1 a-c

Spirillina vivipara var. *densepunctata* CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 8, pp. 4, 5, 1931.

Figures are given of this somewhat trochoid form recently described from Porto Rico. The few specimens in our material came from the stations in Rio de Janeiro Harbor, showing that this variety is probably to be found throughout the general West Indian area. The perforations are usually numerous and closely placed, and in spite of being a planispiral form, there is a tendency for it to become trochoid.

Genus PATELLINA Williamson, 1858

PATELLINA CORRUGATA Williamson

PLATE 4, FIGURE 2

Patellina corrugata CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 8, pp. 11, 12, 1931.

Specimens that seem to be identical with those described by Williamson and others from off Great Britain occur in the material from Port William, Falklands. They have, as is shown in the figure, a low spire and coarse divisions of the chambers. They do not occur in the warmer water to the northward.

PATELLINA ADVENA Cushman

PLATE 4, FIGURE 3

Patellina advena CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 8, p. 13, 1931.

Typical specimens with the very finely divided chambers and rather high spire occur in two of the lots of material from Rio de Janeiro Harbor. The appearance of these two species under the microscope is very distinct, and their distribution is apparently equally distinctive, *P. advena* being a warmer water species, while *P. corrugata* is known only from cold waters.

Genus DISCORBIS Lamarck, 1804

DISCORBIS FLORIDANA Cushman

PLATE 4, FIGURES 5 a-c

Discorbis floridana CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 8, pp. 21, 22, 1931.

A few specimens, which seem to be identical with this species, occur at the various stations in Rio de Janeiro Harbor. One of the

small specimens is here figured, which, although not quite typical, is probably to be assigned to this species.

DISCORBIS MIRA Cushman

Discorbis mira CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 8, pp. 25, 26, 1931.

A very few but very typical specimens occur in Rio de Janeiro Harbor. As this is typically a West Indian species, it would not be expected in the colder-water material.

DISCORBIS CANDEIANA (d'Orbigny)

Discorbis candeiana CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 8, p. 19, 1931.

There are rare specimens of this species described by d'Orbigny from the West Indies occurring with the preceding species.

DISCORBIS NITIDA (Williamson)

PLATE 4, FIGURES 4 a-c

Discorbis nitida CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 8, pp. 26, 27, 1931.

The figured specimen shows a typical specimen of a form that is here assigned to Williamson's species. It shows some differences, in that our form usually has fewer chambers, and the ventral portion has a somewhat more lobed appearance. Otherwise, however, it seems to be very close to this species as developed off the British Isles, and a comparison of specimens from the two areas shows very little difference, except in the points noted. Our specimens are most abundant at the three stations in Rio de Janeiro Harbor, but somewhat similar ones occur at Port William in the Falklands, this being one of the few forms which occurs in the two areas.

Genus EPONIDES Montfort, 1808

EPONIDES PERUVIANUS (d'Orbigny)

Rosalina peruviana d'ORBIGNY, Voyage dans l'Amérique Méridionale, vol. 5, pt. 5, "Foraminifères," p. 35, pl. 2, figs. 3-5, 1839.

Eponides peruviana CUSHMAN and KELLETT, Proc. U. S. Nat. Mus., vol. 75, art. 25, p. 10, pl. 4, figs. 5a-c, 1929.

Test trochoid, nearly equally biconvex, periphery carinate, generally circular in outline; chambers numerous, distinct, about eight in the last-formed whorl, on the dorsal side forming a very even, polished surface, ventrally inflated, giving a very distinct appearance to the test; sutures very distinct on the dorsal side, curved, flush with the surface, slightly limbate, on the ventral side radial, depressed; wall smooth, very finely perforate; aperture ventral, at the base of the chamber between the periphery and the umbilicus.

The original material of d'Orbigny came from the west coast of South America, and apparently has a wide distribution along that coast. A comparison of material from Chile and Peru, described in the above reference, with the abundant material from along the coast of South America and the Falklands, seems to show that they are the same. D'Orbigny's *Rotalina patagonica* shows no trace of the granulations in the sutures, but in the general form and appearance it is very similar to much of the material occurring at the Falklands and off the coast of Argentina, as well as northward at Rivadavia, Brazil. D'Orbigny's figure of *E. peruviana* shows a form with more numerous chambers and an acute periphery, the chambers on the dorsal side limbate and on the ventral side radial and straight. An examination of a great many specimens from both sides of South America leaves one somewhat confused as to the name that should be applied to these specimens. There seem to be gradations between them in several respects. Many of the specimens from the Falklands, for instance, have the same number of chambers and a rounded periphery similar to d'Orbigny's "*patagonica*," but the sutures are always practically radial, have a distinct depressed area, which is finely granular, and frequently have along the periphery a distinct, thickened, keel-like appearance. Probably the only way to finally determine the status of these two species is to examine the type specimens in the original d'Orbigny collection.

Genus *ROTALIA* Lamarck, 1804

ROTALIA BECCARII (Linnaeus) var. *PARKINSONIANA* (d'Orbigny)

Rosalina parkinsoniana D'ORBIGNY, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," p. 99, pl. 4, figs. 25-27, 1839.

Rotalia beccarii (LINNAEUS) var. *parkinsoniana* (D'ORBIGNY), CUSHMAN and COLE, Contr. Cushman Lab. Foram. Res., vol. 6, p. 100, pl. 13, figs. 14 a-c, 1930.

In the West Indian region there is a distinctive form of *Rotalia* to which d'Orbigny gave the specific name "*parkinsoniana*." This is apparently living, widely spread in the general West Indian region, and from our material extends southward as far as Rio de Janeiro Harbor, where it is common at all three stations. The same form has been recorded in the above reference from the Pleistocene of Maryland.

Genus *CANCERIS* Montfort, 1808

CANCERIS SAGRA (d'Orbigny)

Canceris sagra CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 8, pp. 74, 75, 1931.

There are numerous, very typical specimens of this West Indian species from all the stations in Rio de Janeiro Harbor. The series

shows the same general variation of form that is seen in West Indian material and also in that from the Miocene of both Florida and California.

Genus SIPHONINA Reuss, 1849

SIPHONINA PULCHRA Cushman

Siphonina pulchra CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 8, p. 69, 1931.

There were two specimens of this species noted occurring in one of the stations in Rio de Janeiro Harbor.

Family CASSIDULINIDAE

Genus PULVINULINELLA Cushman, 1926

PULVINULINELLA EXIGUA (H. B. Brady)

Pulvinulina exigua H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 696, pl. 103, figs. 13, 14, 1884.

Brady's small species evidently belongs to the genus *Pulvinulinella*. Its aperture is in the plane of coiling and is elongate. It is interesting to find that the two figured specimens in the *Challenger* report are one from the South Atlantic and the other marked "Southern Ocean." We have numerous specimens of very small size, comparing very well with Brady's figures, from several stations in the Falkland Islands.

Genus CASSIDULINA d'Orbigny, 1826

CASSIDULINA CRASSA d'Orbigny

PLATE 4, FIGURES 6 a, b

Cassidulina crassa CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 3, p. 124, 1922.

D'Orbigny's types of this species came from the general region of our collections, and very typical specimens occur in the material from Port William, Falkland Islands. We have also other specimens that are very similar, and perhaps identical, from the stations in Rio de Janeiro Harbor. There are no sizable specimens present in any of the collections, but from Earland we have received some very fine large specimens of this same general form from off the Falklands in deeper water.

Genus CASSIDULINOIDES Cushman, 1927

CASSIDULINOIDES PARKERIANA (H. B. Brady)

PLATE 4, FIGURES 7 a, b

Cassidulina parkeriana H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, p. 59, 1881;
Rep. Voy. *Challenger*, Zoology, vol. 9, p. 432, pl. 54, figs. 11-16, 1884.

All three of the *Challenger* stations from which Brady had this species are "amongst the islands on the west coast of Patagonia." These stations are in much deeper water than is represented by our material. We have very typical specimens from Port William, Falkland Islands, but comparatively rare.

Family ANOMALINIDAE

Genus CIBICIDES Montfort, 1808

CIBICIDES ROBERTSONIANA (H. B. Brady)

Cibicides robertsoniana CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 8, pp. 121, 122, 1931.

Very rare specimens showing the typical color and form of this species occurred in material from Rio de Janeiro Harbor. There are other records for the species from off the coast of Brazil. It was found in the *Albatross* dredgings from the western Atlantic, and seems to be a very distinct species of that part of the world.

CIBICIDES CONCENTRICUS (Cushman)

Cibicides concentricus CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 8, pp. 120, 121, 1931.

This is one of the species originally described from the Miocene of Florida, and later has been found to be fairly common, living off the Florida coast and elsewhere in the West Indian region. A few typical specimens occurred at station 8 in Rio de Janeiro Harbor, thus extending very much to the southward the known range of this species.

Genus DYOCIBICIDES Cushman and Valentine, 1930

DYOCIBICIDES BISERIALIS Cushman and Valentine

PLATE 4, FIGURE 8

Dyocibicides biserialis CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 8, pp. 126, 127, 1931.

All stages from the coiled young to the biserial adult were found in the material from Port William. One of these is figured. It has not, however, occurred at any of the other stations as far as we have noted.

EXPLANATION OF PLATES

PLATE 1

- FIGURE 1. *Proteonina difflugiformis* (H. B. Brady), $\times 60$.
 2. *Glomospira gordialis* (Jones and Parker), $\times 60$.
 3. *Tolypammina vagans* (H. B. Brady), $\times 40$.
 4 a, b. *Haplophragmoides canariensis* (d'Orbigny), $\times 60$. a, Side view; b, peripheral view.
 5, 6. *Quinqueloculina laevigata* d'Orbigny. a, a, b, b, Opposite sides; c, apertural view. Fig. 5, $\times 70$. Fig. 6, $\times 150$.
 7 a-c. *Quinqueloculina lamarckiana* d'Orbigny, $\times 40$. a, b, Opposite sides; c, apertural view.
 8 a-c. *Quinqueloculina costata* d'Orbigny, $\times 70$. a, b, Opposite sides; c, apertural view.
 9 a-c. *Quinqueloculina fusca* H. B. Brady, $\times 70$. a, b, Opposite sides; c, apertural view.
 10 a-c. *Quinqueloculina candeiana* d'Orbigny, $\times 70$. a, b, Opposite sides; c, apertural view.
 11 a-c. *Quinqueloculina isabellei* d'Orbigny, $\times 40$. a, b, Opposite sides; c, apertural view.
 12 a-c. *Triloculina circularis* Bornemann, $\times 50$. a, b, Opposite sides; c, apertural view.
 13 a, b. *Pyrgo subsphaerica* (d'Orbigny), $\times 50$. a, Front view; b, apertural view.

PLATE 2

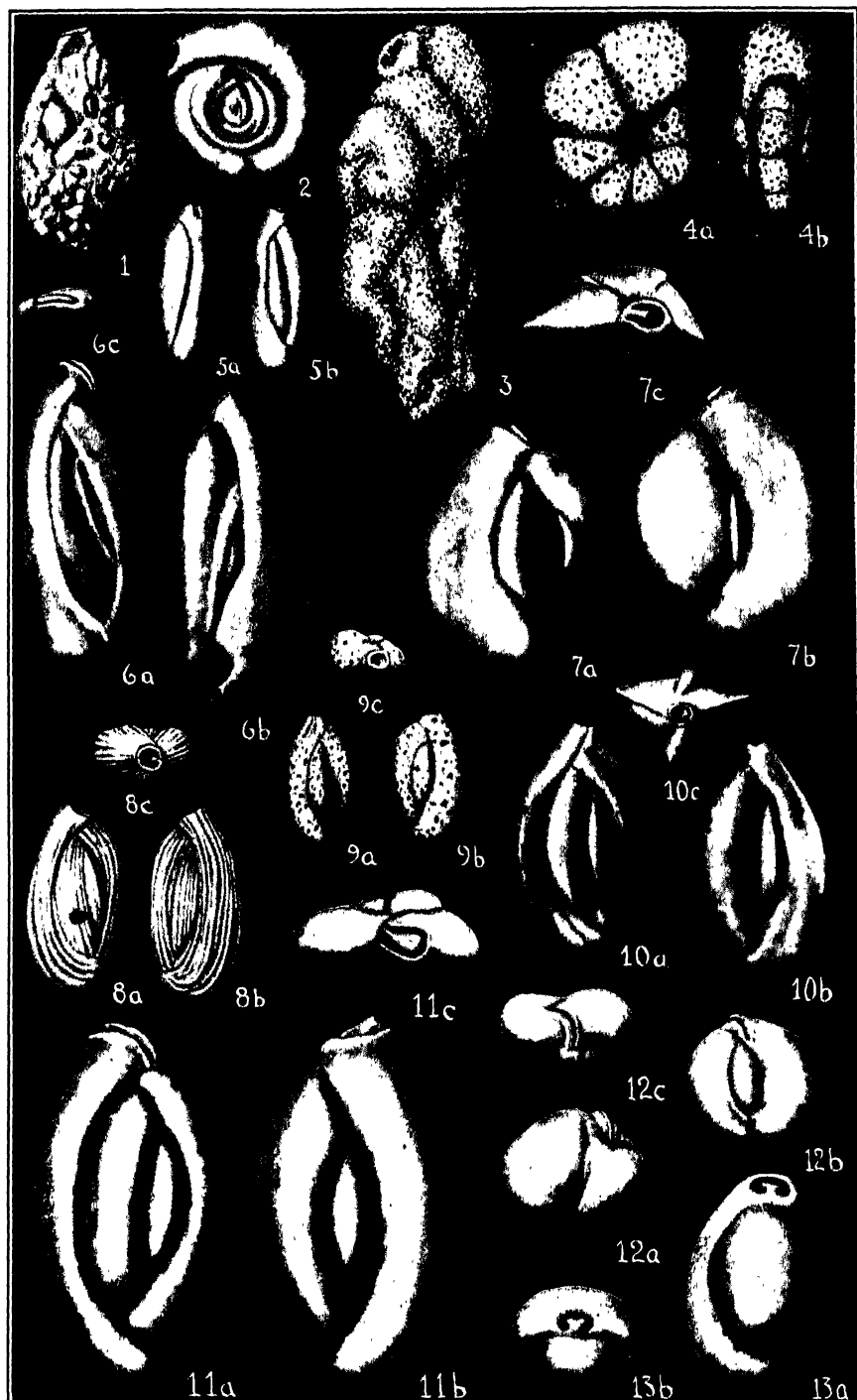
- FIGURE 1. *Cornuspira involvens* Reuss, $\times 70$.
 2 a-c. *Quinqueloculina isabellei* d'Orbigny, $\times 40$. a, b, Opposite sides; c, apertural view.
 3. *Planispirina auriculata* Egger, $\times 70$.
 4 a-c. *Trochammina globigeriniformis* (Parker and Jones), $\times 60$. a, Dorsal view; b, ventral view; c, peripheral view.
 5 a-c. *Trochammina rotaliformis* J. Wright, $\times 70$. a, Dorsal view; b, ventral view; c, peripheral view.
 6 a, b. *Nonion grateloupi* (d'Orbigny), $\times 100$. a, Side view; b, peripheral view.
 7 a-c. *Trochammina peruviana* Cushman and Kellett, $\times 150$. a, Dorsal view; b, ventral view; c, peripheral view.
 8 a, b. *Elphidium australis*, new species, $\times 60$. a, Side view; b, peripheral view.
 9 a, b. *Elphidium alvarezianum* (d'Orbigny) *serrulatum*, new variety, $\times 60$. a, Side view; b, peripheral view.

PLATE 3

- FIGURES 1, 2. *Nodosaria calomorpha* Reuss (?), $\times 70$.
 3, 4. *Nodosaria catesbyi* d'Orbigny, $\times 70$.
 5. *Lagena vilardeboana* (d'Orbigny), $\times 70$.
 6. *Lagena perlucida* (Montagu), $\times 100$.
 7. *Lagena aspera* Reuss, $\times 70$.
 8. *Lagena lyelli* (Seguenza), $\times 70$.
 9. *Lagena caudata* (d'Orbigny), $\times 70$.
 10, 11. *Guttulina lactea* (Walker and Jacob), $\times 70$. Fig. 10, Early stage.
 Fig. 11, Adult.
 12, 13. *Buliminella elegantissima* (d'Orbigny), $\times 120$.
 14. *Bulimina patagonica* d'Orbigny, $\times 70$.
 15 a-c. *Buliminella parallela*, new species, $\times 150$. a, c, Opposite sides;
 b, apertural view.
 16. *Entosolenia compressa* (d'Orbigny), $\times 70$.
 17. *Entosolenia iota* (Cushman) (?), $\times 70$.
 18. *Entosolenia* sp. (?), $\times 70$.
 19. *Bolivina plicatella* Cushman, $\times 70$.
 20. *Bolivina pulchella* (d'Orbigny), $\times 70$.
 21 a, b. *Bolivina striatula* Cushman, $\times 150$. a, Front view; b, apertural
 view.
 22 a, b. *Bolivina tortuosa* H. B. Brady, $\times 150$. a, Front view; b, apertural
 view.
 23 a, b. *Bolivina* sp. (?), $\times 150$. a, Front view; b, apertural view.
 24. *Loxostomum mayori* (Cushman), $\times 50$.
 25, 26. *Siphogenerina* cf. *raphanus* (Parker and Jones), $\times 60$. a, a, Side
 views; b, b, apertural views.

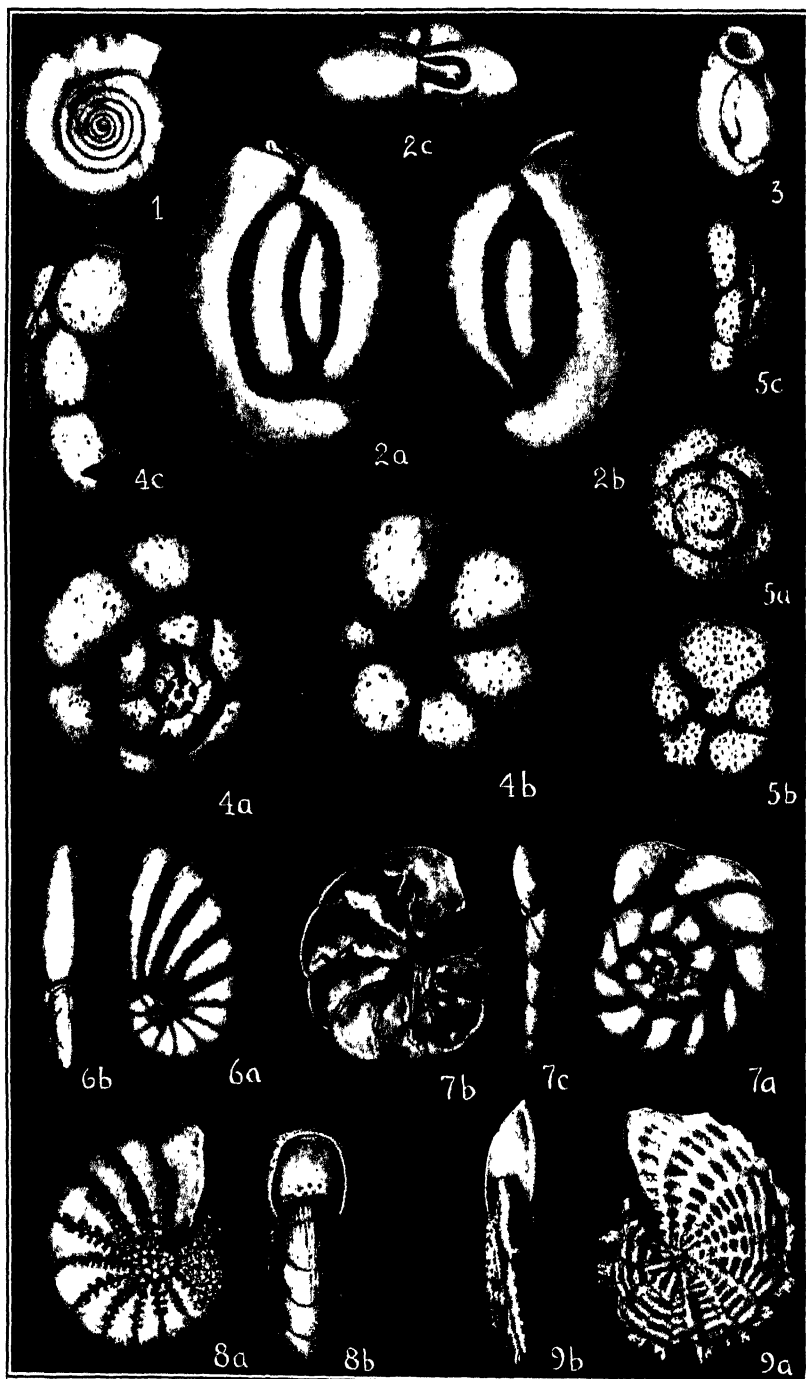
PLATE 4

- FIGURES 1 a-c. *Spirillina vivipara* Ehrenberg var. *densepunctata* Cushman,
 $\times 120$. a, Dorsal view; b, ventral view; c, peripheral view.
 2. *Patellina corrugata* Williamson, $\times 150$.
 3. *Patellina advena* Cushman, $\times 150$.
 4 a-c. *Discorbis nitida* (Williamson) (?), $\times 120$. a, Dorsal view; b,
 ventral view; c, peripheral view.
 5 a-c. *Discorbis floridana* Cushman, $\times 100$. a, Dorsal view; b, ventral
 view; c, peripheral view.
 6 a, b. *Cassidulina crassa* d'Orbigny, $\times 100$. a, Side view; b, peripheral
 view.
 7 a, b. *Cassidulinoides parkeriana* (H. B. Brady), $\times 70$. a, Side view;
 b, peripheral view.
 8. *Dyocibicides biserialis* Cushman and Valentine, $\times 70$.



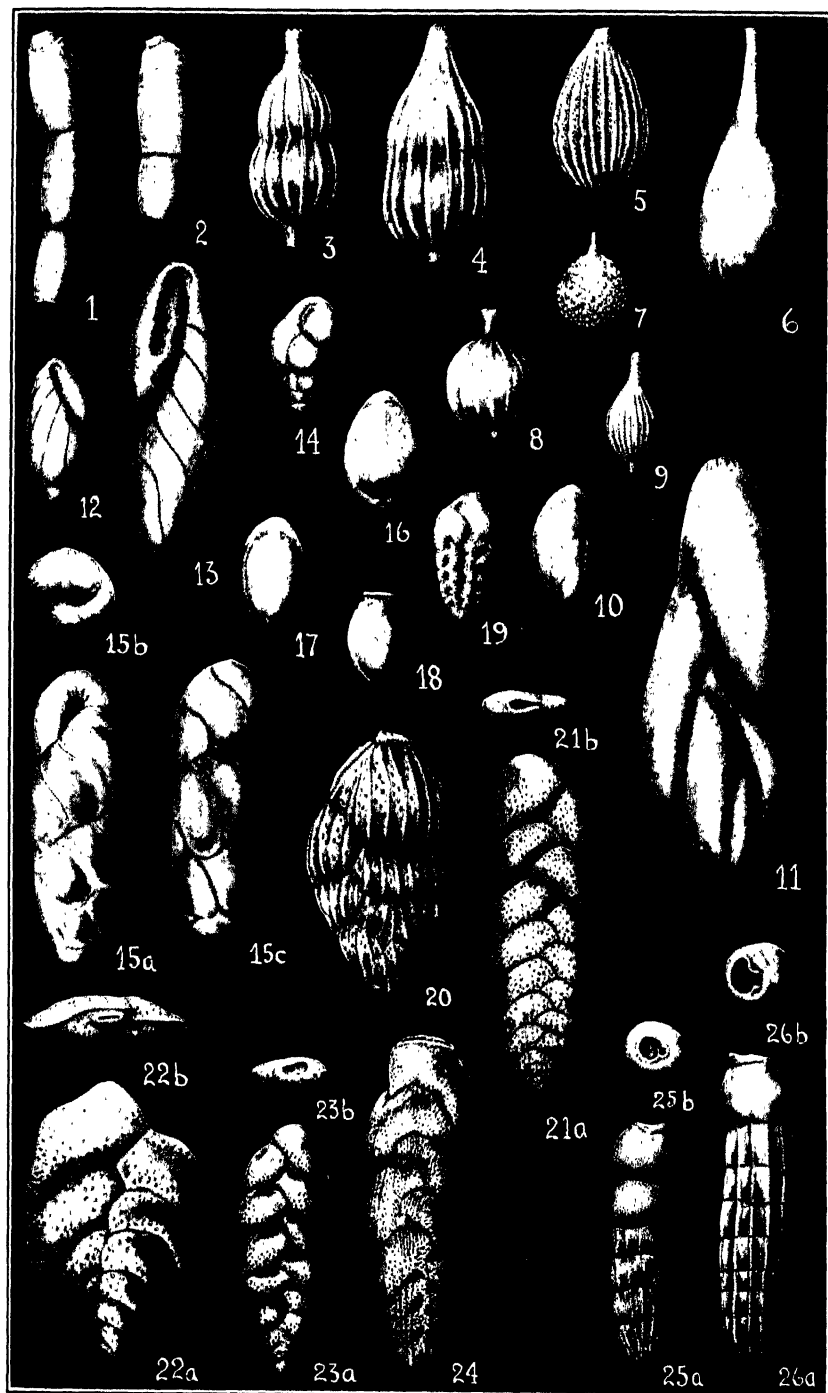
RECENT ATLANTIC FORAMINIFERA FROM SOUTH AMERICA

FOR EXPLANATION OF PLATE SEE PAGE 23.



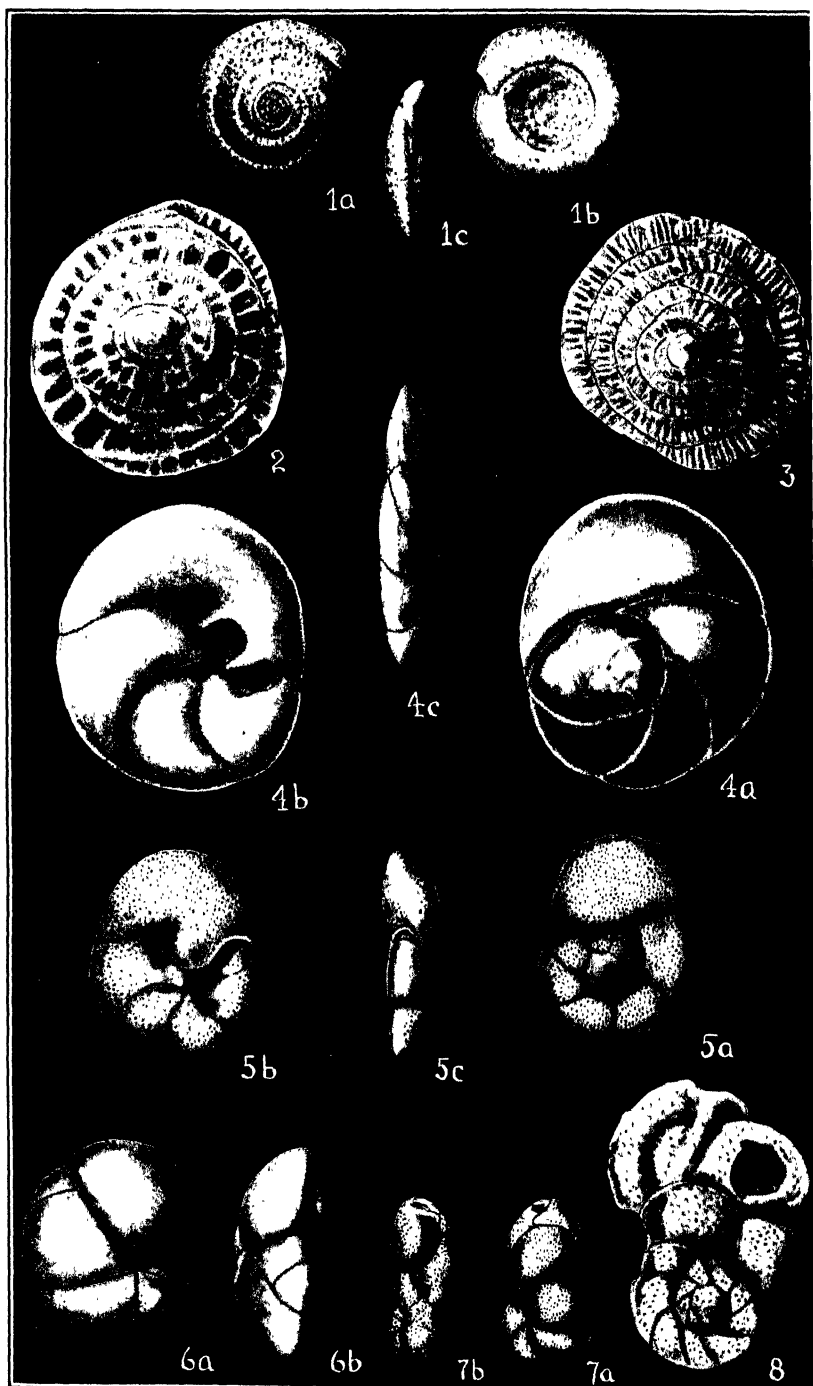
RECENT ATLANTIC FORAMINIFERA FROM SOUTH AMERICA

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RECENT ATLANTIC FORAMINIFERA FROM SOUTH AMERICA

FOR EXPLANATION OF PLATE SEE PAGE 24.



RECENT ATLANTIC FORAMINIFERA FROM SOUTH AMERICA
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THE NORTH AMERICAN BEETLES OF THE GENUS COCCINELLA

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The North American species of the genus *Coccinella* Linnaeus have been studied particularly by Casey (1899) and by Leng (1903). The results arrived at by these authors are, however, quite different. More than twice as many forms are recognized as separate species in the Casey revision as in the more recent survey of Leng. A new survey of the genus is, therefore, desirable. As shown by my studies (1925, 1926) on the palaearctic representatives of the genus *Coccinella*, the structure of the genitalia is a first-class character for the determination of the limits of the species in this genus. Consequently, the description of the genitalia is made the cornerstone of the present study.

A thorough comparison of the American species of *Coccinella* with Eurasiatic ones seems also very desirable. The genus *Coccinella* (limited as defined by me, 1925) inhabits chiefly the holarctic region. Only a few true *Coccinella* live outside of this region. If the holarctic fauna of this genus is properly understood, the world-wide revision of the genus may be easily accomplished.

The present study is based primarily on the examination of the collection of the United States National Museum, which was sent to me through the kindness of Dr. E. A. Chapin. Besides this, collections belonging to the following institutions and individuals were examined: American Museum of Natural History, Cornell University, University of Minnesota, Indiana University, Illinois State Natural History Survey, California Academy of Sciences (including collections of E. C. Van Dyke, F. E. Blaisdell, E. P. Van Duzee, and others), Citrus Experiment Station, F. W. Nunenmacher, A. H. Sturtevant, F. T. Scott, and P. H. Timberlake. I wish to express my gratitude to the owners and to the custodians of these collections for the privilege of examining their material.

The geographical distribution of the species of *Coccinella* is outlined here on the basis of the material personally studied by me. The localities are grouped in the sequence from east to west, and from north to south. The names of the collectors are indicated only for rare or little-known species and for especially interesting finds.

Genus COCCINELLA Linnaeus

Body more or less broadly oval, from moderately to very strongly convex. Head black, with a yellowish-white spot on each side near the eyes, or with a broad transverse white band across the front. Antennae longer than the diameter of the eye, with a compact club. Antennae and mouth parts dark brown or black, the base of the mandible frequently with a white spot; labrum brownish. Pronotum black with quadrangular or triangular white markings in the anterior angles, and in some species also with a white stripe along the anterior margin. Underside black, the episterna and the epimera of the mesosternum and metasternum white in some species. Prosteronum with two carinae, which are slightly convergent anteriorly. Mesosternum not emarginate in the middle of the anterior margin. The coxal lines of the first abdominal sternite divided into two separate branches, one of which runs parallel to the posterior margin of the segment and the other directed toward the anterior angles. Legs black, tibiae with two spurs at the end, tarsal claws with a tooth at base. Elytra yellow, orange, or red with a variable black pattern. The elytral patterns of all the species and varieties of *Coccinella* may be represented as derivatives from the basic pattern consisting of six spots on each elytron (fig. 30). The first of these spots ($\frac{1}{2}$, the scutellar spot) lies on the suture at the scutellum and is common to both elytra; the humeral spot (1) lies at the humeral angles; the lateral spot (2) lies at one-third of the length of the elytron, near the external border; the discal spot (3) at two-fifths of the length of the elytron, closer to the suture than to the external border; the marginal spot (4) at two-thirds of the length of the external border, and the apical spot (5) at four-fifths of the length of the elytron, closer to the suture than to the external border. Among the American species only *Coccinella undecimpunctata* Linnaeus, some varieties of *C. johnsoni* Casey, and *C. transversoguttata* Falderman var. *nugatoria* Mulsant have the basic elytral pattern of the genus unchanged. In all other species some of the spots are either absent or confluent with others. Especially frequent is the fusion of spots 4 and 5 into a common apico-marginal spot (4+5). This fusion is frequently so intimate that the compound nature of the resulting spot may be not at all apparent.

Male genitalia.—The terminology of the parts of the genitalia of Coccinellidae proposed by Verhoeff (1895) seems to me preferable to

that used by other authors. The part functioning in Coccinellidae as a penis is, as shown by its development, homologous to only the proximal part of the penis of other Coleoptera (according to the unpublished data of the author). This part is termed the siphophenis (penis of other authors). Moreover, the penis, which is homologous to the distal part of the penis of other Coleoptera, is intimately fused with the basal plates (basal piece of other authors). The fingerlike paramera (lateral lobes) are articulated with the basal plates. The trabes (tegmenal strut of other authors) is an unpaired chitinous rod articulated to the basal plates, and connected by muscles with the proximal end of the siphophenis.

In the genus *Coccinella* the siphophenis (s, fig. 1 and figs. 13–20) is hook-shaped. Its proximal end, in most species, is strongly chitinized and separated from the body of the siphophenis to form the so-called siphophenical capsule (sc, figs. 1 and 13–20). Only in *Coccinella undecimpunctata* Linnaeus the siphophenical capsule is rudimentary (fig. 20). The distal end of the siphophenis carries rather strongly developed praeputial sacs. The penis (p, figs. 1, 2–12) frequently possesses complicated processes on its distal end. The form of the penis is exceedingly variable and constitutes the best specific character. The trabes (tr, fig. 1) is relatively short and thick, and its free end has no clearly pronounced emargination. The basal plates (bp, fig. 1) are strongly developed. Paramera (pa, figs. 1, 2) are fingerlike and slightly compressed from the sides.

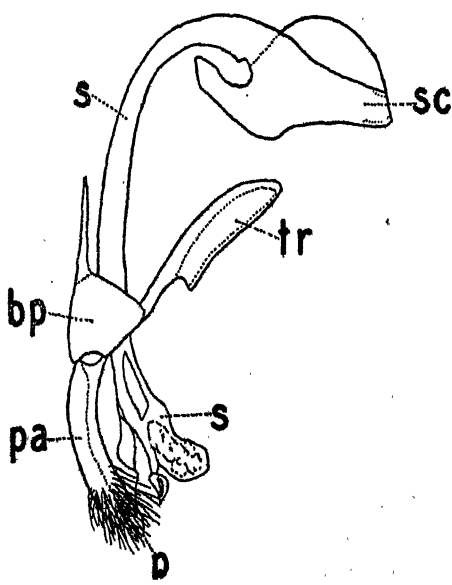


FIGURE 1.—Male genitalia of *Coccinella novemnotata* Herbst (lateral view). bp, Basal plates; p, penis; pa, paramera; s, siphophenis; sc, siphophenical capsule; tr, trabes

Female genitalia.—The receptaculum seminis is large, mostly rather clearly differentiated into the cornu (c, figs. 22, 28), the nodulus (n), and the ramus (r). The sculpture of the walls of the receptaculum, consisting of chitinous rings, is well developed in all species except *Coccinella undecimpunctata* Linnaeus and its relatives. The infundibulum (i, figs. 22, 28) has a funnel-shaped dilatation on its anterior end and, in some species, a similar dilatation on its posterior end. The ductus receptaculi (dr, fig. 28) is very short and nearly hidden in the

funnel-shaped dilatation of the infundibulum. Some species have an accessory plate (Verhoeff's Anhangsplatte, loc. cit.) attached to the posterior end of the infundibulum (ap, fig. 22).

COCCINELLA NOVMNOTATA Herbst

Coccinella novemnotata HERBST, *Natursystem der Käfer*, vol. 5, p. 269, 1793.—CASEY, 1899, p. 88.—LENG, 1903, p. 198; 1920, p. 216.—JOHNSON, 1910, pp. 59–60.

Body subhemispherical. Head with a broad, undulate, yellowish-white band across the front, and with yellow anterior margin of the clypeus. Pronotum and pronotal epipleura with white subquadrate marks in the anterior angles, anterior margin of the pronotum more or less broadly white. Mesepimera and metepimera, the posterior ends of the metepisterna, and in males a spot on the anterior coxae and a stripe on the anterior femora, yellowish white. Head, pronotum, and elytra alutaceous, obscurely punctulate with the punctures somewhat stronger near the external margin of the elytra. Elytra yellow or orange, with nine black spots ($\frac{1}{2}$, 1, 2, 3, 4). The spot $\frac{1}{2}$ moderate in size, triangular or rhomboidal, spots 1 and 2 small and usually rounded, spots 3 and 4 large in size and transversely elliptical in shape. The spots may fuse together or may be connected by rather slender black lines. The following patterns have been described: 1+2 (conjuncta Fitch), 3+5, $\frac{1}{2}$ +3, 2+1+3, 2+1+3+5 (confluenta Fitch). Length of body, 5.3–7 mm.

Male genitalia (figs. 2, 13).—Penis rather long and narrow, its proximal end extended in a triangular process. Paramera much shorter than penis. Basal plates broader than long. Siphon rather long and slender.

Female genitalia (fig. 21).—Cornu broad, ramus very small, nodulus conic in shape and thick-walled. Infundibulum short and thick, its posterior end dilated and surrounded by a ringlike furrow.

This purely American species seems to be related to the palaearctic species *Coccinella divaricata* Olivier (= *distincta* Redtenbacher). The points of similarity are the sculpture of the elytra, the shape of the elytral spots, and the shape of the siphon and the infundibulum. The form of the penis is, however, very different in these two species.

Geographic distribution.—Localities as follows:

Quebec: Montreal, Chelsea.

Ontario: Britannia.

New Hampshire: Lancaster, Mount Washington, Franconia, Wolfeboro.

Vermont: Ludlow.

Massachusetts: Melrose, Medford, Arlington, Stoughton, Springfield, Plymouth, Middleboro, North Saugus, Woods Hole, Falmouth, Truro, Siasconset, Oak Bluffs, Edgartown, Nantucket Island, New Bedford.

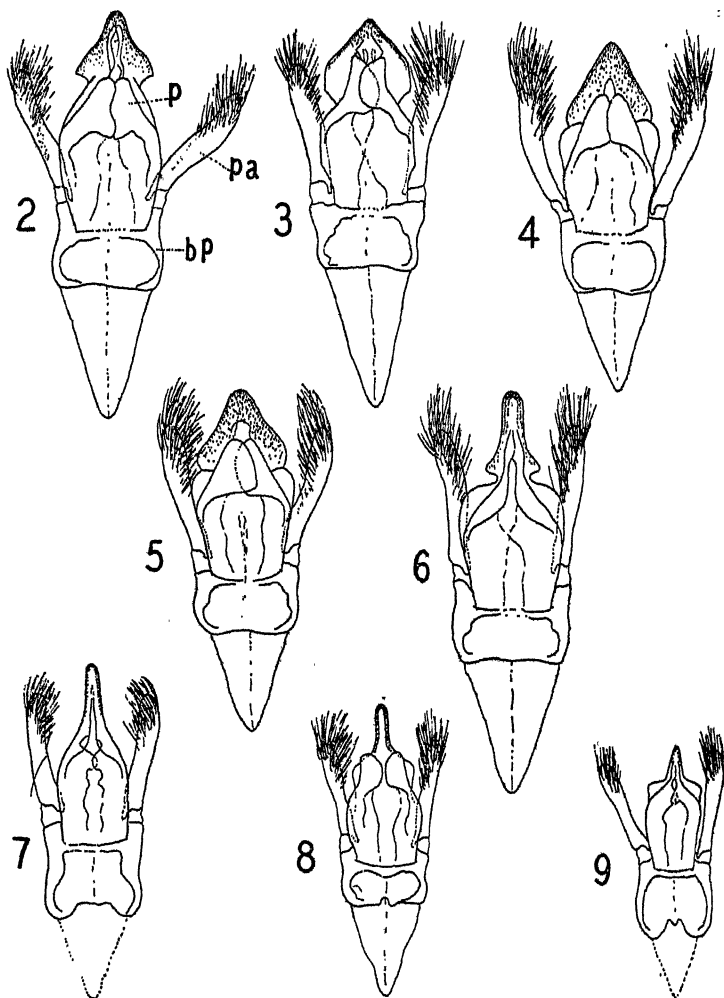
Rhode Island: Watch Hill.

Connecticut: Brookfield, Bridgeport.

New York: Black Mountain, Thousand Islands, Kinderhook, White Lake, New York, Farmingdale, Cold Spring Harbor, Riverhead, West Point, Ithaca, Forest Lawn, Honeoye Falls, Batavia, Dansville.

New Jersey: Fort Lee, Hackensack, Paterson, Passaic, Ramsey, Boonton, Newton, Mendham, Milltown, Lakehurst.

Pennsylvania: Philadelphia, Ashbourne, Glenside, Reading, Lehigh Gap, Gettysburg.



FIGURES 2-9.—Male genitalia of the different species of *Coccinella*: 2, *Coccinella novemnotata*; 3, *C. prolongata*; 4, *C. californica*; 5, *C. johnsoni*; 6, *C. transversoguttata*; 7, *C. niticola*; 8, *C. suturalis*; 9, *C. difficilis*. In all figures the siphon and the tracheae are not represented. bp, Basal plates; p, penis; pa, paramera

Delaware: Newark.

Maryland: Baltimore, Hagerstown, Odenton, Glen Echo, Riverdale.

District of Columbia: Washington.

Virginia: Falls Church, Vienna, Arlington, Fredericksburg, Bowling Green, Cuckoo, Richmond, Norfolk, Blue Ridge Mountains, Staunton, Afton, Peaks of Otter, Pennington Gap.

West Virginia: White Sulphur Springs.

North Carolina: Arcola, Southern Pines, Salisbury, Black Mountain.

South Carolina: Oswego, Batesburg, Beaufort.

Georgia: La Grange, Baconton, Moultrie, Thomasville.

Florida: State record.

Michigan: Whitefish Point, Marquette, Port Huron, Detroit, Douglas.

Ohio: Newton Falls, Salineville, Columbus.

Indiana: Knox, Culver, Nashville, Bloomington, Mineral.

Illinois: Chicago, Kankakee, Fulton, Oakwood, Urbana, St. Joseph, Champaign,
White Heath, Charleston, Topeca, Havana, Dubois, Metropolis.

Kentucky: Campton.

Tennessee: Black Mountains, Coal Creek.

Alabama: Longview.

Louisiana: Tallulah, Mound.

Wisconsin: Waupaca, Madison, Osceola.

Minnesota: St. Paul, Minneapolis, High Prairie, Hennepin County, Lake Crystal,
Minnehaha Creek, Lake City, Jordan, Shakopee, Rice County, St. Peter,
Lesueur Center, Albert Lea, Owatonna, Mora, Brooten, Princeton, New Lon-
don, Taylors Falls, Willow River, Houston County, Itasca Lake, Luverne,
Ramsey.

Iowa: Muscatine, Ames.

Missouri: St. Louis, Utica, Willard.

Arkansas: Siloam Springs.

South Dakota: Madison, Black Hills.

Oklahoma: Hobart.

Texas: Dallas.

Wyoming: Carbon County.

Colorado: Boulder, Colorado Springs, Manitou, Rocky Ford.

Remarks.—In the individuals coming from the Eastern and Southern States the elytral spots are distinctly larger than in those from Minnesota, Missouri, and Iowa. Specimens from Wyoming and Colorado are intermediate between the typical *novemnotata* and the variety *degener* Casey (see below). Moreover, the frequency of specimens having confluent elytral spots is higher in Eastern and Southern States, and lower in the Middle West.

COCCINELLA NOVEMNOTATA Herbst subspecies **DEGENER** Casey

Coccinella degener CASEY, 1899, p. 88.

Coccinella novemnotata Herbst var. *degener* Casey, LENG, 1903, p. 198; 1920, p. 216.—JOHNSON, 1910, p. 59.

This race differs from the typical form by smaller size of the body, more polished surface of the elytra, and by smaller, sometimes absent, elytral spots. The genitalia of both sexes are not significantly different from those of the typical *novemnotata* Herbst. The geographic distribution of *degener* Casey gives a convincing evidence in favor of considering it as a subspecies of *novemnotata* Herbst, and not as a separate species. Length of the body, 4.8-6.2 mm.

Geographic distribution.—Localities as follows:

Saskatchewan: Carlyle.

Nebraska: Mitchell.

Kansas: Douglas County.

Oklahoma: Summit, Hobart.

Montana: Assiniboine, Bear Paw Mountains, Helena, Powderville, Broadwater County, Yellowstone County.

Wyoming: Big Horn Mountains, Canyon Camp (Yellowstone Park), Wheatland, Cheyenne, Carbon County.

Colorado: Pine Creek, Fort Collins, Greeley, Dixon, Boulder, Longs Peak (9,000 feet), Summit County, Golden, Denver, Florissant, Manitou, Colorado Springs, Rocky Ford, Buena Vista, Paonia, Salida.

New Mexico: Espanola, Santa Fe, Albuquerque, Koehler Junction, Coolidge.

Idaho: Moscow, Pocatello, Jerome, Twin Falls, Nampa.

Utah: Salt Lake City, American Fork, Saltair, Taylorsville, Murray, Holliday, Fort Douglas, Emigration Canyon, St. George.

Nevada: State record.

Arizona: Grand Canyon, Bright Angel, Williams, Flagstaff, Clemenceau.

Remarks.—The Middle West representatives are clearly intermediate between *degener* and the typical *novemnotata*. The variability of all the characters in which these subspecies differ from each other is very high in this region. On the other hand, many individuals from the western part of the distribution of *degener* have some of the spots on the elytra very small or missing. The subspecies *degener* is thus connected with the subspecies *oregona* Casey and *franciscana* Mulsant by a series of intergrades.

COCCINELLA NOVENNOTATA Herbst subspecies OREGONA Casey

Coccinella novemnotata Herbst subspecies *oregona* CASEY, 1908, p. 403.—LENG, 1920, p. 216.

This subspecies is very close to *degener* Casey. It differs from it by the larger size of the body (equal to that of the typical *novemnotata* Herbst), by very dense but obscure punctation, and by very small and frequently missing elytral spots. The surface of the elytra is more polished than in either *novemnotata novemnotata* or *novemnotata degener*.

Geographic distribution.—Localities as follows:

British Columbia: Vernon, Midday Valley, Merritt, Nanaimo, Victoria, Departure Bay.

Washington: Fairfield, Pullman, Blue Mountains, Coulee City, Ritzville, Paha, Toppenish, Paradise Inn (Mount Rainier National Park), Olympia, Tenino.

Oregon: Wallowa Mountains, La Grande, Portland, McMinnville, Coast Range (Benton County), Corvallis, Klamath County, Amity.

California: Modoc County, Klamath Lake, Lassen County, Carrville, Plumas County, Mono County.

Remarks.—This subspecies occupies the northern Pacific States. In California it finds the southern limit of its distribution, and is connected by numerous intermediates with the more southern subspecies, namely *franciscana* Mulsant.

COCCINELLA NOVENNOTATA Herbst subspecies FRANCISCANA Mulsant

Coccinella franciscana MULSANT, 1853, p. 19.

Coccinella californica CASEY (partim), 1899, p. 89; 1908, p. 404.

Coccinella novemnotata Herbst var. *franciscana* Mulsant, LENG, 1903, p. 198; 1920, p. 216.—JOHNSON, 1910, p. 59.

This race differs from other subspecies of *novemnotata* Herbst by the absence of all or most of the elytral spots, by the bright red of the elytra, and by the polished and shiny surface of the elytra. The individuals from southern California are usually spotless; those from San Joaquin Valley usually have a few of the spots characteristic for other subspecies of *novemnotata* Herbst. The *Coccinella* living in San Joaquin Valley may thus be considered intermediate between the subspecies *oregona* Casey and *franciscana* Mulsant. Casey (loc. cit.) considered *franciscana* Mulsant as a synonym for *Coccinella californica* Mannerheim. This view is unfounded. Even without consideration of the structure of the genitalia, the presence of the white margin of the pronotum in *franciscana* Mulsant is evidence against such a supposition.

Geographic distribution.—Localities as follows:

California: Klamath Springs, Carrville, Oroville, Yuba County, Lake Tahoe, Truckee, Placerville, Mokelumne Hill, Valley Springs, Tuolumne County, Patterson, Fresno, Coalinga, Huntington Lake (7,000 feet), Independence, Visalia, Lemoncove, Lindsay, Bakersfield, San Fernando, Mint Canyon, Mount Lowe, Mount Wilson, Pasadena, Los Angeles, Whittier, Arcadia, Monrovia, Fish Canyon, Riverside, Balboa, San Diego, Coronado, Poway, Imperial County.

Utah: St. George.

Arizona: Yuma.

New Mexico: Espanola.

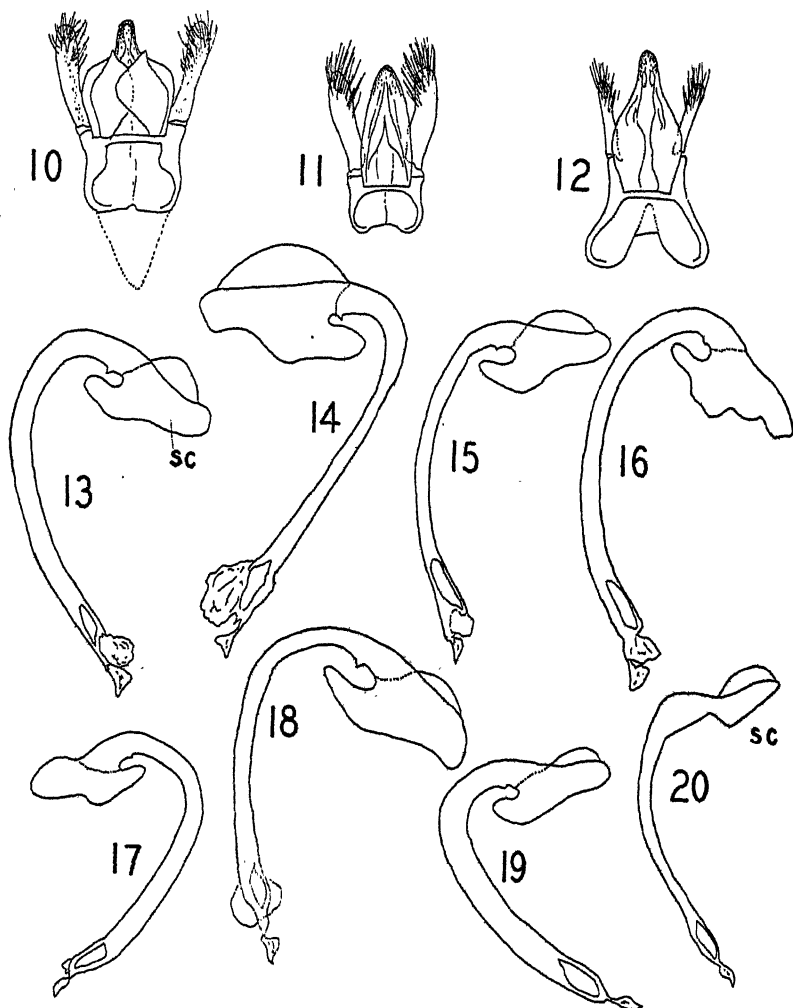
Remarks.—The distribution of *franciscana* Mulsant exhibits an interesting feature. This form is frequent in regions where *Coccinella californica* Mannerheim is absent, and is lacking or occurs only seldom in places where *C. californica* is frequent. Practically the only region where the distribution of the two species overlaps is the vicinity of Los Angeles. In general, *californica* occupies the region west of the Coast Range, while *franciscana* lives east of the Coast Range. Such a relationship seems typical for close species which are not far from being only subspecies of the same species. This is, however, hardly true in respect of *franciscana* and *californica*. Indeed, *californica* seems to be related closely to *transversoguttata* Falderman and not to *novemnotata* Herbst. On the other hand, *franciscana* is beyond doubt a subspecies of *novemnotata*. Perhaps the explanation of this peculiarity of distribution of the two species lies in some of their ecological peculiarities.

COCCINELLA PROLONGATA Crotch

Coccinella prolongata CROTCH, 1873, p. 371.—CASEY, 1899, p. 88.—JOHNSON, 1910, p. 64.

Coccinella transversoguttata Falderman var. *prolongata* Crotch, LENG, 1903, p. 199.

Coccinella monticola Mulsant var. *prolongata* Crotch, LENG, 1920, p. 216.



FIGURES 10-12.—Male genitalia of *Coccinella trifasciata*, *C. hieroglyphica*, and *C. undecimpunctata*, respectively. The siphon and the trapes are not represented.

FIGURES 13-20.—Siphon of the different species of *Coccinella*: 13, *C. novemnotata*; 14, *C. prolongata*; 15, *C. californica*; 16, *C. difficilis*; 17, *C. hieroglyphica*; 18, *C. nivicola*; 19, *C. trifasciata*; 20, *C. undecimpunctata*. sc, Siphonal capsule

More elongately oval than *C. novemnotata* Herbst, moderately convex, the sides of the elytra subparallel in the middle of their length, the convexity of the elytra very great in the posterior third of their length. Head black with very large white spots near the eyes, leav-

ing only a narrow black bridge between them. Mesepimera and metepimera, the posterior ends of the metepisterna, and, in the males, a spot on the anterior coxae, white. White markings in the anterior angles of the pronotum are extended toward the posterior angles and toward the middle of the disk, and, in most cases, are united by a narrow white stripe on the anterior margin of the pronotum. Anterior angles of the pronotal epipleura broadly white. Pronotum and the elytra alutaceous, rather densely and very finely punctulate, with punctures somewhat stronger than in *novemnotata* Herbst. Elytra yellow or orange with a large rhomboidal scutellar spot ($\frac{1}{2}$), a small round spot (2), a large obliquo-transverse spot (3), and a transverse spot in the apical third of their length (4+5), which sometimes is separated into two spots (4 and 5). Length of the body, 6.2–7 mm.

Male genitalia (figs. 3, 14).—Similar to those of *C. novemnotata* Herbst, but penis shorter, its sides angulate, the proximal end extended into a very broad, rhomboidal process. Basal plates wider than long. Siphon very large, the siphonal capsule developed more strongly than in any other species of *Coccinella*.

Female genitalia.—Unknown.

Geographic distribution.—Localities as follows:

Montana: Helena (W. M. Mann, collector).

Wyoming: Yellowstone National Park (W. Robinson, collector).

Kansas: State record (National Museum collection).

Colorado: Denver, Garland (National Museum collection).

Washington: Wenatchee (E. J. Newcomer, collector).

Remarks.—This species is rather closely related to *C. novemnotata* Herbst because of the structure of the genitalia, the punctuation of the elytra, and the presence of the white spots on the anterior coxae in the males. I can not agree, therefore, with the opinion of Mr. Leng that *prolongata* Crotch is a variety of *nivicola* Menetries (*monticola* Mulsant). I find no characters indicating such a relationship except the pattern of the elytra, which is indeed similar to *C. nivicola* Menetries var. *alutacea* Casey. On the other hand, the genitalia of *prolongata* Crotch are quite sufficiently different from those of *novemnotata* Herbst to consider them separate species. The area of habitation of *prolongata* is completely included in that of *novemnotata*.

COCCINELLA PROLONGATA Crotch SEQUOIAE new subspecies

Similar to *Coccinella prolongata* Crotch but with the frontal spots smaller, with the quadrangular white spots in the anterior angles of the pronotum not dilated, elytra much more strongly punctate, intervals very finely alutaceous, reddish testaceous, elytral spots 3+2+4+5+3+ $\frac{1}{2}$ +3+5+4+2+3 confluent.

This race differs from the typical form in a rather large series of characters. The white markings on the pronotum are not extended

toward the posterior angles or toward the disk; the white stripe on anterior margin of the pronotum is missing. The mesepimera and metepimera are white, and the anterior coxae of the males have a white spot, as in *prolongata*. The convexity of the elytra is more regular than in *prolongata*, but less regular than in other species of *Coccinella*. The elytral spots are strongly increased in size and confluent with one another. Spots 2, 3, 4, and 5 form a ringlike pattern, which in most specimens is connected with spot $\frac{1}{2}$. The elytral suture is red, at least in the posterior half of its length. The male genitalia are slightly different from those of the typical *prolongata*. The process on the distal end of the penis is somewhat longer and more pointed at the end; the sides of the penis are more rounded. In spite of all these differences, I consider this form a subspecies of *prolongata* rather than a separate species.

Geographic distribution.—Localities as follows:

California: Sequoia National Park, near Camp Wolverton (7,000 to 9,000 feet June 24–25, 1929, 51 specimens, E. C. Van Dyke, collector; ibidem, June 29, 1930, 2 specimens, T. Dobzhansky, collector; the type in the California Academy of Sciences collection).

COCCINELLA PROLONGATA Crotch subspecies **BRIDWELLI** Nunenmacher

Coccinella bridwelli NUNENMACHER, Ent. News, vol. 24, p. 76, 1913.—LENG, 1920, p. 216.

This subspecies is different from the typical form and from the subspecies *sequoiae* Dobzhansky by the smaller size and the less convex shape of the body, by the more strongly alutaceous surface, and the color of elytra. Elytra entirely black. The white markings on the head and the pronotum, and the punctuation of the elytra, as in *sequoiae*. Mesepimera white, metepimera usually white, but in some specimens black (the type of *bridwelli*, according to Nunenmacher's description, has black metepimera). Three out of the five males studied had white spots on the anterior coxae. The genitalia not distinguishable from those of *sequoiae*. Length of body, 5.5–6.3 mm.

This is one of the three entirely black forms known in the genus *Coccinella*. It is more similar to the subspecies *sequoiae* than to the typical form. The subspecies *sequoiae* may be considered as an intermediate form between the subspecies *bridwelli* Nunenmacher and the typical *prolongata* Crotch.

Geographic distribution.—Localities as follows:

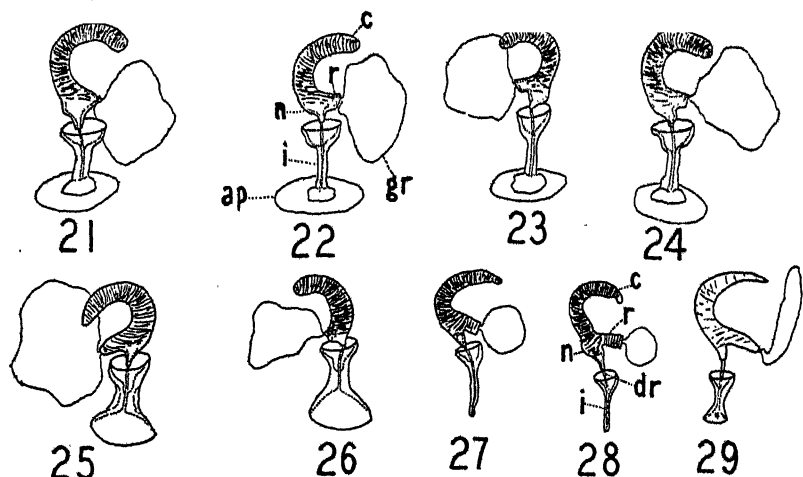
California: Tahquitz Valley (type and cotypes, J. C. Bridwell, collector), Tahquitz Canyon (E. C. Van Dyke, collector), Idyllwild (E. C. Van Dyke, collector).

COCCINELLA CALIFORNICA Mannerheim

Coccinella californica MANNERHEIM, Bull. Soc. Imp. Nat. Moscou, vol. 16, p. 312, 1843.—CASEY, 1899, pp. 88, 89.—JOHNSON, 1910, p. 62.

Coccinella transversoguttata Falderman var. *californica* Mannerheim, LENG, 1903, p. 200; 1920, p. 216.

Body broadly oval, strongly convex. Head with a white spot on each side near the eyes, pronotum with a quadrangular mark in the anterior angles, pronotal epipleura with a narrow white margin. The variety *melanocollis* Casey has the whole pronotum black. Mesepimera white, metepimera black. Pronotum and elytra slightly alutaceous, densely but finely punctulate, the punctures becoming stronger toward the external margin of the elytra. Elytra bright red or orange with a black scutellar spot ($\frac{1}{2}$) and with a narrow black stripe along the suture. In some specimens the elytra are entirely red (var. *nevadica* Casey?). Very seldom individuals occur having rudiments of the elytral spot 1, or the spot 3, or both. Length of the body, 5.4–6.5 mm.



FIGURES 21-29.—Receptaculum seminis and infundibulum of the different species of the genus *Coccinella*: 21, *Coccinella novemnotata*; 22, *C. californica*; 23, *C. johnsoni*; 24, *C. transversoguttata*; 25, *C. nicola*; 26, *C. difficilis*; 27, *C. trifasciata*; 28, *C. hieroglyphica*; 29, *C. undecimpunctata*. *ap*, Accessory plate; *c*, cornu; *dr*, ductus receptaculi; *i*, infundibulum; *gr*, accessory gland of the receptaculum seminis; *n*, nodulus; *r*, ramus]

Male genitalia (figs. 4, 15).—Penis slightly longer than the paramera, broadening distally, deeply emarginated in the distal half of its length, and extended into a very broad triangular process. Basal plates broader than long. Siphro shorter than in *C. transversoguttata* Falderman and in *C. novemnotata* Herbst.

Female genitalia (fig. 22).—Receptaculum seminis similar to that of *C. novemnotata* and *C. transversoguttata*. The infundibulum longer and more slender than in the species just mentioned.

This species is rather closely related to *C. transversoguttata*. This relationship is correctly recognized by Leng, but these species must be undoubtedly considered separate because of the difference in the structure of the genitalia, as well as in the external characters. I place *Coccinella nevadica* Casey as a synonym of *californica* Mannerheim with much hesitancy. I have not examined the Casey type

specimen, and the description of it is unsatisfactory. *C. nevadica* may also be a spotless variety of *C. nivicola* Menetries, or even may be synonymous with *C. novemnotata* Herbst var. *franciscana* Mulsant.

Geographic distribution.—Localities as follows:

British Columbia: Victoria, Nanaimo, Departure Bay.

Washington: Whatcom, Port Townsend, Seattle, Forks, Hoquiam.

Oregon: Astoria, Cannon Beach, Tillamook, Otter Rocks, Agate Beach.

California: Arcata, Samoa, Eureka, Scotia, Fortuna, Orick, Klamath, Sisson (J. Bradley collector), Chilcoot (Essig collector), Mendocino, Guerneville, Santa Rosa, Petaluma, Fairfield, San Rafael, Mount Tamalpais, Sausalito, Cazadero, Berkeley, Oakland, Alameda, Sacramento County (Citrus Experiment Station collection), Merced County (F. T. Scott collector), San Francisco, San Mateo, Redwood City, Palo Alto, Santa Clara, San Jose, Los Gatos, Santa Cruz, Morgan Hill, Salinas, Spreckels, Del Monte, Monterey, Pacific Grove, Carmel, Soledad, Pinnacles National Monument, King City, Lindsay (R. Jones collector), Guadalupe, Betteravia, Los Alamos, Lompoc, Santa Ynez, Santa Barbara, Santa Paula, Oxnard, Santa Monica, Mint Canyon, Saugus, San Fernando, Pasadena, Mount Wilson, Mount Lowe, Los Angeles, Arcadia, Monrovia, Fish Canyon, San Gabriel Canyon, Pomona, Whittier, San Pedro, Santa Ana, Balboa, Laguna Beach, San Juan Capistrano, Fall Brook, La Jolla, San Diego, El Cajon, Santa Rosa Island, Santa Cruz Island, San Nicolas Island (S. Emerson collector), San Clemente Island.

Lower California: Ensenada, Descanso Bay, Guadalupe Island.

Arizona: Senator (American Museum of Natural History collection).

Remarks.—One may conclude from the data presented above that *C. californica* is very common between the Coast Range and the Pacific Ocean, but occurs only very seldom between the Coast Range and the Sierra Nevada. It is the commonest species of *Coccinella* in the Los Angeles region, but seems to be entirely absent in the Mohave Desert. F. T. Scott informs me that *C. californica* is not found in the central part of the San Joaquin Valley, being replaced there by *C. novemnotata* Herbst var. *franciscana* Mulsant, which is not very common in the Los Angeles region. The finding of *C. californica* in Arizona and at Lindsay, Calif. (see above) seems to be very doubtful. It is probable that this species will be found also along the western coast of the northern part of Mexico.

COCCINELLA JOHNSONI Casey

Coccinella johnsoni CASEY, 1908, p. 403.—JOHNSON, 1910, p. 61.

Coccinella novemnotata Herbst. var. *johnsoni* Casey, LENG, 1920, p. 216.

Body more elongate and less convex than in *C. californica* Mannerheim. Punctulation of the pronotum and the elytra somewhat stronger than in the latter species. Elytra red with the 11 spots constituting the typical pattern of the genus *Coccinella* (fig. 30), and with a narrow black stripe along the suture. Spots 4 and 5 lie close to each other, and are frequently confluent. The black sutural margin may be absent; likewise spot 2, or spot 4, or both, may be absent. Spot

$\frac{1}{2}$ may be fused with spot 1 to form a transverse black fascia. Length of the body, 5.8–6.8 mm.

Male genitalia (fig. 5).—Resembling those of *C. californica*; but the process on the distal end of the penis shorter, broader, and less acuminate at the end.

Female genitalia (fig. 23).—Not distinguishable from *C. californica*.

This species is very close to *C. californica* but not to *C. novemnotata*, as suggested by Johnson and Leng. Its specific rank may be, however, a subject of dispute. Indeed, the very small differences in the structure of the genitalia and in the form of the body might make it questionable. No intermediates between the two species occur, however, in spite of the fact that the whole known distribution of *C. johnsoni* is included in that of *C. californica*. Notwithstanding the smallness of the differences between the two species, and the variability of the elytral pattern of *C. johnsoni*, they may be distinguished without difficulty. The species described by Casey (1908, p. 402) from northern Mexico, namely, *Coccinella sonorica*, is almost certainly a color variation of *C. johnsoni*.

Geographic distribution.—Localities as follows:

British Columbia: Victoria (California Academy of Sciences collection).

Washington: Orcas Island (W. M. Mann collector), King County (F. W. Nunenmacher collection).

California: Shively (E. O. Essig collector), San Francisco (F. T. Scott collector), Santa Paula, Pasadena, Fish Canyon, Santa Ana, Santa Monica, Costa Mesa, San Diego, Coronado, San Nicolas Island (S. Emerson collector), San Clemente Island (F. Blaisdell collector).

Remarks.—The individuals from British Columbia and Washington are rather considerably different from those from California in being less convex, in having the apex of the elytra acuminate, and in having very small elytral spots. This fact suggests that the species *C. johnsoni* is differentiated into two subspecies, one of which is living in British Columbia and Washington and the other living in California. It seems to be wise, however, not to propose Latin names to these subspecies until more material is available.

COCCINELLA TRANSVERSOGUTTATA Falderman

Coccinella transversoguttata FALDERMAN, Mem. Soc. Imp. Nat. Moscou, vol. 4, p. 454, 1835.—LENG, 1903, p. 199; 1920, p. 216.—JOHNSON, 1910, pp. 61, 62.

Coccinella quinquenotata KIRBY, Richardson's Fauna Boreali-Americana, p. 230, 1837.—CASEY, 1899, p. 89; 1908, p. 401.

Coccinella transversalis MULSANT, 1850, p. 117.

Body broadly oval, very strongly convex. Head with a white spot on each side near the eyes, pronotum with white quadrangular marks in the anterior angles, pronotal epipleura narrowly white in the anterior angles. Mesepimera white, metepimera brown or black. Head, pronotum, and elytra densely and rather strongly punctulate, the

punctures becoming stronger toward the external margin of the elytra. Elytra yellow or red with a common black subbasal fascia (spots $1 + \frac{1}{2} + 1$), a very small spot near the external margin (2), which is mostly absent in the American specimens (var. *quinquenotata* Kirby), a large transversely oval spot on the disk (3), and a subapical transverse fascia (spots 4 + 5). The subbasal fascia and spot 3 are reduced in the western specimens to narrow black stripes (var. *transversalis* Mulsant). Length of the body, 5.8–7.2 mm.

Male genitalia (fig. 6).—Penis longer than the paramera, rather wide, deeply emarginated in the distal half of its length, the distal end extended into a tonguelike process. Basal plates wider than long.

Female genitalia (fig. 24).—Receptaculum seminis similar to that of *C. novemnotata* Herbst, but shorter, wider, and with slightly thinner walls. Infundibulum also similar to that of *C. novemnotata*, but relatively longer and more slender.

Casey (1899) insisted on calling the American representatives of this species *quinquenotata* Kirby, and on restricting the name *transversoguttata* Faldeman to the Asiatic representatives. I see no sufficient reason for such a separation, since the only difference between the American and the Asiatic representatives of this species is the frequent absence of spot 2 in the former. The absence of this spot is, however, observed also in Asiatic specimens, though as an exception, and its presence is sometimes observed in American individuals. The genitalia are completely alike in the American and in the Asiatic specimens (see Dobzhansky, 1926, fig. 1). Consequently, it seems superfluous to preserve the name *quinquenotata* Kirby even as a sub-specific name.

Geographic distribution.—Localities as follows:

Nova Scotia: Truro.

Quebec: Montreal.

Ontario: North Bay, Ottawa, Toronto, Port Credit, Huntsville, Ridgeway.

Manitoba: Mile 214 on Hudson Bay Railroad, Winnipeg, Aweme.

Mackenzie: Great Slave Lake (National Museum collection).

Saskatchewan: Prince Albert, Carlyle.

Alberta: Calgary, Banff.

Alaska: New Rampart House (J. M. Jessup collector), Skagway (Harrington collector), Chitina Glacier (30 miles north of Mount St. Elias) (D. W. Eaton collector).

Yukon: Whitehorse (J. A. Kusche collector), Dawson (J. A. Kusche collector), White Pass (J. A. Kusche collector), Carcross (Harrington collector).

British Columbia: Vernon, Penticton, Merritt, Fort McLeod, Vancouver.

New Hampshire: Mount Washington, White Mountains, Lancaster, Franconia, Wolfeboro, Barnstead.

Massachusetts: Arlington, Boston, Cambridge, Forest Hills, Winchester, Truro, Woods Hole.

Connecticut: Bridgeport.

New York: Thousand Islands, Whiteface Mountain, Batavia, Ithaca, Honeoye Falls, West Point, Broadalbin.

New Jersey: Riverton.

Delaware: Wilmington.

Pennsylvania: State record.

Virginia: Fredericksburg.

Michigan: Whitefish Point, Marquette, Alpena, Daggett, Douglas.

Ohio: Lake County.

Illinois: State record.

Wisconsin: Waupaca, Winneconne.

Minnesota: Two Harbors, Duluth, St. Louis County, Itasca County, Beltrami County, Marshal County, Norman County, Otter Lake, North Branch, Taylors Falls, Ramsey County, Anoka, St. Paul, Minneapolis, Lake City, Lake Crystal, New London, Luverne.

Iowa: Muscatine, Crawford County.

Missouri: Belgrade.

North Dakota: Trail County, Bismarck, Fargo, Valley City, Drake, Oakdale, Bismarck, Mott.

South Dakota: Black Hills.

Texas: San Antonio, Colorado County.

Montana: Moccasin.

Wyoming: Big Horn Mountains, Cheyenne, Owl Creek Mountains, Cannon Camp (Yellowstone National Park), Paint Creek, Carbon County, Green River.

Colorado: Greeley, Pingree Park, Longmont, Boulder, Longs Peak Inn (9,000 feet), Golden, Denver, Grant, Rocky Ford, Fowler, Colorado Springs, Manitou, Canon City, Leadville (10,000 feet), Paonia, Grand Junction, Veta Pass, Garland, San Luis, Dark Canyon.

New Mexico: Chama, Aztec, Espanola, Las Vegas Hot Springs (7,000 feet), Chuska Mountains (8,800 feet).

Idaho: Moscow, Lewiston, Blackfoot, Pocatello, Jerome, Twin Falls, Boise.

Utah: Logan, Promontory, Huntsville, Kaysville, Coalville, Salt Lake City, Taylorsville, Kamas, Park City, Heber, Silverlake, Alta, Murray, Sandy, Lehi, West Jordan, Provo, Emigration Canyon, Fort Douglas, Price, Beaver Mountains (8,000–10,000 feet), St. George.

Arizona: Williams, Chiricahui Mountains.

Washington: Pullman, Ritzville, Paha, Coulee, Wenatchee, Toppenish, Seattle, Tacoma, Paradise Park (Mount Rainier, 6,000 feet).

Oregon: Baker, Cascade Rapids, Portland.

Nevada: Shell Canon (Ruby Mountains), Reno, Steamboat Springs, Lyon County, Esmeralda County.

California: Modoc County, Madeline, Truckee, Lake Tahoe, Mono County, Ryan (Dobzhansky collector).

This form is apparently lacking in southern California.

COCCINELLA TRANSVERSOGUTTATA Falderman subspecies **NUGATORIA** Mulsant

Coccinella nugatoria Mulsant, 1850, p. 1021.—CASEY 1908, p. 403.

Coccinella transversoguttata Falderman var. *nugatoria* Mulsant; LENG, 1903, p. 199; 1920, p. 216.—JOHNSON, 1910, p. 61.

This is a western subspecies of *C. transversoguttata* Falderman, differing from the typical form by smaller size, less convex elytra, finer punctuation, and by the reduction of the pigmentation of the elytra. Spots $\frac{1}{2}$ and 1 are separate, spot $\frac{1}{2}$ is transversely oval or pyriform, spot 1 is round and small, spot 2 usually absent, spot 3 is smaller

and more narrowly oval than in *transversoguttata*, spots 4 and 5 frequently separate. Spot 1, or spot 4, or both, may be missing. Length of the body, 5.8–6.5 mm.

Casey (1899) insisted on granting a specific rank to *C. nugatoria* Mulsant. In fact it is only a rather indistinct subspecies of *C. transversoguttata* Falderman living in the Western States and in Mexico. An enormous area extending from North Dakota and New Mexico to the Pacific Ocean is inhabited by a mixed population in which all the intermediates between the typical *transversoguttata* Falderman and the typical *nugatoria* Mulsant may occur. Only in Mexico is the whole population *nugatoria*. The genitalia of *transversoguttata* (from Massachusetts) and of *nugatoria* (from California) are alike.

Geographic distribution.—Localities as follows:

Minnesota: Two Harbors, New London, Lake City.

North Dakota: Binford, Bismarck.

Wyoming: Cheyenne, Como, Carbon County.

Colorado: Pingree Park, Denver, Manitou, Leadville (10,000 feet), Vega.

New Mexico: Chama.

Idaho: Lewiston, Jerome, Boise, Nampa.

Utah: Ogden Canyon, Emery County, Taylorsville, Salt Lake City, Murray Park City.

British Columbia: Vernon, Penticton, Merritt, Vancouver.

Washington: Pullman, Toppenish, Tacoma, Wapato.

Oregon: Cascade Rapids.

Nevada: Carson City, Esmeralda County, Nixon.

California: Modoc County, Madeline, Nevada County, Big Pine.

Mexico: Queretaro, Mexico City, Guadalajara.

COCCINELLA NIVICOLA Menetries subspecies **MONTICOLA** Mulsant

Coccinella monticola MULSANT, 1850, p. 115.—CASEY, 1899, p. 89.—LENG, 1903, p. 198; 1920, p. 216.—JOHNSON, 1910, p. 63.

Coccinella lacustris LECONTE, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, p. 131, 1852.

Coccinella impressa CASEY, 1899, p. 89; 1908, p. 402.

Broadly oval, strongly convex. Head with white spots near the eyes, pronotum with white quadrangular spots in anterior angles, pronotal epipleura with quadrangular marks or with only a white stripe in the anterior angles. Mesepimera white, metepimera brown or black. The sides of the pronotum frequently possess one or several impressions, which are variable in extent but which may be altogether lacking. Individuals with very strongly developed impressions on the pronotum were described by Casey (1899) as a separate species, *Coccinella impressa*. In a more recent paper, Casey (1908, p. 402) treated *impressa* as a subspecies of *monticola* Mulsant. The character is, however, only an individual variation, and in my opinion the name *impressa* must be treated simply as a synonym of *monticola*. Elytra

orange or yellow, alutaceous, punctation dense and strong, becoming stronger toward the external margin, with a very large pyriform scutellar spot ($\frac{1}{2}$), an oblique transverse fascia not attaining the suture or the external margin (spots 2+3), and with a large, transversally oval spot in the apical third (spots 4+5). Length of the body, 5.8–7 mm.

Male genitalia (figs. 7, 18).—Penis considerably longer than the paramera, slightly wider at the middle of its length than at the base, rapidly narrowing distally, the distal end extended into rather long fingerlike process. Basal plates longer than wide.

Female genitalia (fig. 25).—Receptaculum seminis short and wide, with ringlike sculpture on its walls rather delicate. Infundibulum short and thick, its posterior end with a funnel-shaped dilatation, the diameter of which is nearly twice as much as the diameter of the anterior dilatation of the infundibulum. Accessory plate absent.

I find *C. monticola* Mulsant not specifically distinct from the Asiatic species *Coccinella nivicola* Menetries. The typical *nivicola* (from eastern Siberia) differs from *monticola* in having the anterior fascia extended toward the humeral angles and in having a stronger punctulation of the elytra. Both characters are, however, variable. Individuals of *monticola* from Canada and the Northern United States have the elytral fascia very broad, and frequently extended toward the humeral angles. On the other hand, individuals of *nivicola* from southern Siberia, Mongolia, and Djungaria have the elytral pattern approaching that of *monticola*. Even more important is the fact that the genitalia of *nivicola* (see Dobzhansky, 1926, fig. 6) are identical with those of *monticola*. Thus, *monticola* must be considered a subspecific form of *nivicola*, equivalent to the subspecies *alutacea* Casey.

Geographic distribution.—Localities as follows:

Quebec: Quebec, Hudson Bay (University of Minnesota collection).

New Hampshire: Mount Washington, Lancaster, Franconia.

Michigan: Whitefish Point.

Minnesota: Duluth, Itasca Park.

Montana: Glacier National Park (T. Ulke collector), Missoula (National Museum collection).

Utah: Brighton (National Museum collection).

Colorado: Rogers Pass (Bradley collector).

Florida: State record (Illinois State Natural History Survey collection; this record is very doubtful).

California: Lassen National Park (8,000–10,000 feet, Dobzhansky collector), Tallac (A. Feneys collector), Fallen Leaf (California Academy of Sciences collection), Eldorado County (Blaisdell collector), Mono (Blaisdell collector);

Remarks.—The individuals from Montana, Colorado, and Utah are intermediate between *monticola* and *alutacea*. Those from California have the elytral pattern similar to that of *monticola* from New England, but one individual has the anterior fascia connected with the scutellar spot.

COCCINELLA NIVICOLA Menetries subspecies ALUTACEA Casey

Coccinella alutacea CASEY, 1899, p. 89.

Coccinella transversoguttata Falderman var. *alutacea* Casey, LENG, 1903, p. 200.

Coccinella monticola Mulsant var. *alutacea* Casey, JOHNSON, 1910, p. 63.—LENG, 1920, p. 216.

Differs from the typical *nivicola* Menetries and from var. *monticola* Mulsant by the more strongly alutaceous surface of the elytra; the finer and sparser punctulation, and by the reduced pigmentation of the elytra. The shape of the body is less convex in *alutacea* than in *monticola*. The scutellar spot is rather small, the black fascia narrow, frequently disintegrating into a small round spot 2, and a large transversally oval spot 3. The apico-marginal spot (4+5) small, round or transversally oval. Spot 2, or spot 4+5, or both, may disappear (var. *biguttata* Johnson). Metepimera and the posterior ends of the metepisterna usually brown or yellow, though specimens having black metepimera also occur. The genitalia of both sexes are identical with those of typical *nivicola* and of subspecies *monticola*. Leng and Johnson were correct in not recognizing this variety as a separate species.

Geographic distribution.—Localities as follows:

Kansas: State record (Illinois State Natural History Survey collection).

South Dakota: Ardmore.

Montana: Assiniboine, Missoula, Yellowstone County.

Wyoming: Newcastle, Big Horn Mountains, Yellowstone National Park, Grand Teton National Park, Cheyenne, Green River (6,000–7,000 feet).

Colorado: Pingree Park, Fort Collins, Longmont, Boulder, Denver, Golden, Cimarron, Garden of the Gods, Manitou, Colorado Springs, Rocky Ford, La Veta, Leadville, Buena Vista, Paonia, Saguache.

New Mexico: Chama, Espanola, Santa Fe, Las Vegas Hot Springs, Elida, Albuquerque.

Idaho: Snake Canyon, Blackfoot, Burley.

Utah: Uinta National Forest, Alta, Salt Lake City, Silverlake, Murray, Heber, Logan, Emery County, Beaver Creek Hills, Iron County, St. George.

Arizona: San Francisco Mountains (7,900 feet) (Cornell University collection).

Nevada: Elko, Ely, Lovelock, Ormsby County, Nixon, Lamaille.

British Columbia: Fort McLeod, Vancouver, Victoria.

Washington: Sprague Lake, Toppenish, Paradise Park (Mount Rainier, 6,000 feet).

Oregon: Vale, Huntington, Lake County, Dallas.

California: Davis, Modoc County (California Academy of Sciences collection), Siskiyou County, Klamath (F. W. Nunenmacher collection), Lassen County (F. W. Nunenmacher collection), Plumas County (F. W. Nunenmacher collection), Madeline, Piedmont (F. W. Nunenmacher collector), Truckee (California Academy of Sciences collection), Bullfrog Lake (10,600 feet) (California Academy of Sciences collection).

Remarks.—Individuals from western Utah, Nevada, and California are characterized by an extreme reduction of the pigmentation of the elytra. Indeed, most of them have only spot 3 (var. *biguttata* Johnson), or only spot 5. Besides this they are usually smaller, less

convex, and more elongate-oval than the typical *alutacea* from more eastern localities. Perhaps this race deserves being called a separate subspecies, but more material is needed before its status can be established definitely. It must be noted that this very light race is recorded in the Sierra Nevada in nearly the same localities in which *monticola* Mulsant (see above) is recorded. In spite of this no intergrades between these very different races are so far observed. The genitalia of the Californian *alutacea* were studied and found to be not distinguishable from other specimens of *alutacea* or from *monticola*. The whole question certainly deserves further study.

COCCINELLA DIFFICILIS Crotch

Coccinella difficilis CROTCH, 1873, p. 370.—LENG, 1903, p. 200.—JOHNSON 1910, p. 64.

Coccinella monticola Mulsant var. *difficilis* Crotch, LENG, 1920, p. 216.

Coccinella vandykei NUNENMACHER, Ent. News, vol. 20, p. 161, 1909.

Coccinella transversoguttata Faldernan var. *vandykei* Nunenmacher, LENG, 1920, p. 216.

Broadly oval, rather strongly convex. Head with white spots near the eyes, labrum brown, the anterior angles of the pronotum with quadrangular white marks, the anterior angles of the pronotal epipleura with a narrow white margin. Pronotum and elytra non-alutaceous, densely and finely punctulate. Elytra orange or red with a large scutellar spot ($\frac{1}{2}$), a small, round, frequently missing spot 2, a large, transversally elliptical spot 3, and a very large transverse apico-marginal spot (4+5), tending to break into two separate spots. Mesepimera and metepimera white. Length of the body, 5.4–6.3 mm.

Male genitalia (figs. 9, 16).—Penis only slightly longer than the paramera, gradually widening from the base in the distal direction, sharply narrowed at two-thirds of its length, and extended into a fingerlike process. Basal plates longer than wide. Siphon very long as compared with the size of the penis. Siphonal capsule angulate.

Female genitalia (fig. 26).—Receptaculum seminis short and wide; ramus rudimentary. Infundibulum similar to that of *Coccinella nivicola* Menetries.

This species is surprisingly close to *Coccinella tianshanica* Dobzhansky from middle Asia. The external structures as well as the genitalia are similar, though not identical, in the two species. They differ in the sculpture of the elytra, in the form of spot 4+5, in the form of the penis, and that of the receptaculum seminis. Among the American species of *Coccinella* the only close relative of *difficilis* is *C. suturalis* Casey. The two species just mentioned, and the Asiatic species *tianshanica* Dobzhansky and *iranica* Dobzhansky, form a separate section of the genus *Coccinella*. *C. nivicola* Menetries belongs,

however, to the group of species headed by the palaearctic species *C. septempunctata* Linnaeus. Though these two sections of the genus are related to each other, I can not agree with Leng, who places both *difficilis* Crotch and *suturalis* Casey as varieties of *nivicola* Menetries. *Coccinella vandykei* Nunenmacher is a synonym of *difficilis* Crotch.

Geographic distribution.—Localities as follows:

Montana: Helena (National Museum collection), Gallatin County (National Museum collection).

Wyoming: Cheyenne, Green River.

Colorado: Colorado Springs (National Museum collection).

Idaho: Bingham County, Pocatello, Jerome, Boise.

Utah: Salt Lake City, Beaver Valley, South Creek, Beaver County.

Nevada: Elko (H. F. Wickham collector), Lovelock (F. E. Blaisdell collector), Goldfield (Nunenmacher collector, type and two cotypes of *C. vandykei* Nunenmacher).

California: Chilcoot (Essig collector).

COCCINELLA SUTURALIS Casey

Coccinella suturalis CASEY, 1899, p. 89.—JOHNSON 1910, p. 64.

Coccinella monticola Mulsant var. *suturalis* Casey, LENG, 1903, p. 198; 1920, p. 216.

Elongate-oval, less convex than any other American species of *Coccinella*. Head and pronotum similar to *C. difficilis* Casey. Anterior angles of the pronotal epipleura with quadrangular white marks in females, and only narrowly white in males. Mesepimera white, metepimera black. Punctulation of the pronotum and of the elytra dense and strong, becoming much stronger toward the external margin of the elytra and toward the sides of the pronotum. Elytra orange, with a large, obcordiform scutellar spot ($\frac{1}{2}$), a rather broad black stripe along the suture, an oblique black fascia on the disk (spots 2 + 3), and a transversal black spot in the posterior third of the length (spots 4 + 5). Length of the body, 5.5–5.8 mm.

Male genitalia (fig. 8).—Penis similar to that of *C. difficilis* Crotch, but considerably longer than the paramera, the distal process much longer and less pointed at the end. Basal plates wider than long. Siphonal capsule not angulate.

Female genitalia.—Unknown.

Coccinella suturalis Casey is related to *difficilis* Crotch, but differs from it in the shape of the body, in the punctulation and the pattern of the elytra, and in the structure of the genitalia.

Geographic distribution.—Localities as follows:

Utah: Alta (Hubbard and Schwarz collection).

California (Fresno County): Mount Kaiser (10,000 feet) (California Academy of Sciences collection), Mount Gould (12,000 feet) (California Academy of Sciences collection), Bubbs Creek (9,700 feet) (California Academy of Sciences collection).

COCCINELLA TRIFASCIATA Linnaeus

Coccinella trifasciata LINNAEUS, Systema naturae, p. 365, 1758.—LENG, 1903, p. 200.

Coccinella perplexa MULSANT, 1850, p. 1021.—CASEY, 1899, p. 89.—JOHNSON, 1910, p. 57.—LENG, 1920, p. 216.

Broadly oval, strongly convex. Head in females with white spots near the eyes, in males with a broad white stripe across the front. Pronotum with triangular or quadrangular white marks in the anterior angles, and with white anterior margin, pronotal epipleura with quadrangular white marks in the anterior angles. Mesepimera and metepimera, and usually also the posterior ends of the metepisterna, white. Pronotum densely and finely punctulate, punctures on the elytra nearly as dense as those on the pronotum but considerably stronger. Elytra yellow or orange with three transverse black fasciae; the anterior fascia is common to both elytra (it is the result of the fusion of the spots $1 + \frac{1}{2} + 1$). The median fascia (spots $2 + 3$), and the posterior fascia (spots $4 + 5$) do not reach the suture or the external margin. Length of the body, 4.5–5.5 mm.

Male genitalia (figs. 10, 19).—Penis short and wide, pyriform in shape, its distal end extended into a short process. Paramera only slightly, if at all, shorter than penis. Basal plates not wider than long. Sipho very short and thick, the siphonal capsule rather small and rounded.

Female genitalia (fig. 27).—Receptaculum seminis long and slender, cornu almost pointed at the end, ramus wide, infundibulum not dilatated at the posterior end.

The American representatives of this species were described under the name *perplexa* Mulsant. The identity of *perplexa* Mulsant with the palaearctic species *trifasciata* Linnaeus was the subject of a dispute between Casey and Leng (see Casey, 1908). I find myself in a complete agreement with Leng, who regards *perplexa* as a mere synonym of *trifasciata*. The only difference between the American and the Eurasiatic specimens of this species is the presence of the white margin of the pronotum in the former. Johnson (1910) found an individual of *perplexa* having no white margin on the pronotum. Furthermore, this character is sometimes found also in Asiatic specimens (Dobzhansky, 1926). The genitalia of the American and the Asiatic specimens are quite alike (cf. Dobzhansky, 1926, fig. 10). It seems that *perplexa* can not be considered even as a subspecifically distinct form, and therefore the name should be dropped.

Geographic distribution.—Localities as follows:

Nova Scotia: Truro.

New Brunswick: Hampton.

Quebec: St. Hilaire, Lavaltrie, Fort Coulonge.

Ontario: Ottawa, Huntsville, North Bay, Toronto, Chatham, Hudson Bay (University of Minnesota collection).

Manitoba: Aweme, Mile 17 on Hudson Bay Railroad.

Alberta: Banff.

Alaska: Mountain Sheep Creek (22 miles below Eagle) (Harrington collector).

Yukon: Dawson (J. M. Jessup collector), Whitehorse (J. A. Kusche collector).

British Columbia: Glacier, Agassiz, Vernon, Victoria.

Maine: Orono, Boothbay, Casco Bay.

New Hampshire: Mount Washington, Lancaster, Franconia, Center Harbor, Farmington, Barnstead, Nashua.

Massachusetts: Boston, Arlington, Melrose Highlands, Princeton, Cambridge, Stoughton, West Medford, Middleboro, North Saugus, Falmouth, Woods Hole, Oak Bluffs.

Rhode Island: Watch Hill.

Connecticut: South Windsor, New Haven, Cromwell, Brookfield.

New York: Adirondack Mountains, Mount Whiteface, Mount McIntire, Newcomb, Wilmington, Lake Placid, Middletown, West Point, Larchmont, Pelham Bay, New York, Staten Island, Ithaca.

New Jersey: Fort Lee, Passaic, Ramsey, Great Notch, Newark, Westwood, Paterson, Chester, Boonton.

Pennsylvania: State record.

Maryland: State record.

Michigan: Whitefish Point, Alpena, Detroit.

Wisconsin: Madison.

Minnesota: Grand Marais, Two Harbors, Duluth, Itasca County, Roseau County, Minneapolis, St. Paul, Lake City, Beaver Dam, Lake Crystal, St. Antony.

North Dakota: State record.

Montana: Bear Paw Mountains, Columbia Falls.

Wyoming: Yellowstone National Park.

Colorado: Larimer County, La Veta.

New Mexico: Maxwell (National Museum collection).

Texas: State record (National Museum collection).

Idaho: Moscow, Ashton.

Utah: Logan (California Academy of Sciences collection).

Washington: Pullman.

California: Eureka, Klamath (Dobzhansky collector).

Remarks.—The individuals from Montana, Wyoming, Colorado, New Mexico, Idaho, and Utah are similar to those from the Northeastern States. A few individuals from Washington, Oregon, and California are probably extreme variants of the subspecies *subversa* LeConte.

COCCINELLA TRIFASCIATA Linnaeus subspecies **SUBVERSA** LeConte

Coccinella subversa LeConte, Proc. Acad. Nat. Sci. Philadelphia, vol. 7, p. 19, 1854.—CASEY, 1899, p. 89.

Coccinella perplexa Mulsant var. *subversa* LeConte, JOHNSON, 1910, p. 57.—LENG, 1920, p. 216.

Differs from the typical *trifasciata* by the distinctly smaller size of the body and by a strong reduction of the black pigmentation of the elytra. Elytra spotless, or with only the scutellar spot ($\frac{1}{2}$), or with only a very small discal spot (3), or with both the scutellar and the discal spots. In any case, the size of the scutellar and the discal spots is very much decreased as compared with typical *trifasciata*,

the pigment is often brownish instead of black, and the outlines of the spots are frequently diffuse and indistinct. Length of the body, 4.3–5 mm.

According to Casey (1899, 1908) this is a species separate from *trifasciata* (*perplexa*). The opinion of Leng and Johnson seems to be, however, better founded. An investigation of the genitalia of a large series of specimens of *C. subversa* from Oregon failed to reveal any difference between it and the typical *C. trifasciata* from the Eastern States, except, perhaps, an insignificant difference in the absolute size. Thus, *C. subversa* may be classified as a good example of a subspecific form.

Geographic distribution. Localities as follows:

British Columbia: Agassiz, Vancouver, Wellington, Victoria.

Washington: Orcas Island, Mount Vernon, Everett, Port Angeles, Seattle, Tacoma, Puyallup, North Bend, Easton, Paradise Park (Mount Rainier), Longmire (Mount Rainier), Tenino, Oakville, Vancouver.

Oregon: Astoria, Agate Beach, Neskowin, Olney, Portland, Hillsboro, Forest Grove, Cannon Beach, Tillamook, McMinnville, Siuslaw National Forest, Wilsonville, Corvallis, Waldport, North Bend, Josephine County.

California: Scotia, Fortuna, Orick, Klamath, Hydesville, Sonoma County, Berkeley, Oakland.

Remarks.—As shown by the list of localities, the subspecies is abundant in Washington and Oregon, in the whole region between the Cascade Range and the Pacific Ocean. Its distribution extends to British Columbia, where it overlaps the distribution of the typical *C. trifasciata*. In the south the distribution of *subversa* overlaps that of the subspecies *eugenii* Mulsant and *juliana* Mulsant. It must be noted, however, that the individuals of *subversa* from California have the form of the body and the punctuation of the elytra more similar to that of *juliana* than to that of *subversa* from Oregon and Washington. The parts of Oregon and Washington lying east of the Cascade Range are apparently inhabited by typical *trifasciata*. Thus the Cascade Range appears to be the line dividing the two subspecies.

COCCINELLA TRIFASCIATA, Linnaeus subspecies EUGENII Mulsant

Coccinella eugenii MULSANT, 1866, p. 95.

Coccinella trifasciata Linnaeus var. *eugenii* Mulsant, LENG, 1903, p. 200.

Coccinella perplexa Mulsant var. *eugenii* Mulsant, JOHNSON, 1910, p. 57.—LENG, 1920, p. 216.

This is a geographical race intermediate between the subspecies *subversa* LeConte and the subspecies *juliana* Mulsant. The size and the punctuation of the elytra are as in *subversa*. The pattern of the elytra may consist of the three transverse fasciae similar to those of the typical *trifasciata* but much narrower and showing a clear tendency to disintegrate into separate spots. More frequently the intermediate fascia is broken into a small round spot 2 and an oblong,

transverse spot 3. The subapical fascia may also disintegrate into two small, usually round spots (4 and 5). Equally frequently the intermediate and the subapical fasciae remain intact, but the humeral fascia resolves itself into a round humeral spot (1) and a transverse scutellar spot ($\frac{1}{2}$). Finally, all the fasciae may disintegrate, resulting in a pattern similar to the typical pattern of the genus *Coccinella* (fig. 30). Some spots, especially 2, 4, and 1, may be absent.

Geographic distribution.—Localities as follows:

Oregon: Cannon Beach, Tillamook, Coolestin.

California: Modoc County, Mount Shasta, Shively, Sisson, Cayton, Arcata, Eureka, Scotia, Fortuna, Orick, Klamath, Hydesville, Mendocino, Guerneville, Lagunitas, Fairfax, Albany, Alameda, Piedmont, San Francisco, Los Gatos, Napa County, Plumas County, Tallac, Tahoe, Half Moon.

Remarks.—The distribution of this subspecies overlaps that of the subspecies *juliana* Mulsant. The subspecies *eugeni* Mulsant is, however, more frequent in the northern part of California than in the San Francisco region. The reverse holds true for *juliana*.

COCCINELLA TRIFASCIATA Linnaeus subspecies JULIANA Mulsant

Coccinella juliana MULSANT, 1856, p. 135.—CASEY, 1899, p. 89.

Coccinella barda LeCONTE, 1859, p. 286.

Coccinella trifasciata Linnaeus var. *juliana* Mulsant, LENG, 1903, p. 200.

Coccinella perplexa Mulsant var. *juliana* Mulsant, JOHNSON, 1910, p. 57.—LENG, 1920, p. 216.

More oblong but not less convex than other varieties of *C. trifasciata*. Punctuation of the pronotum and of the elytra finer and sparser than in typical *trifasciata*; elytra shining. Pigmentation of the elytra strongly reduced. Usually only the humeral fascia is present, the two other fasciae being absent completely. The humeral fascia may resolve itself into separate spots ($\frac{1}{2}$ and 1). Small blotches of dark pigment may be present on the places occupied in other varieties by the spots 3, 4, and 5. Length of the body, 4.6–5.3 mm.

The genitalia of the subspecies *juliana* are not different from those of the typical *trifasciata* or from those of the subspecies *subversa* LeConte. This fact, as well as the absence of marked external differences, indicates that *juliana* is a geographical race of *trifasciata* and not a separate species. The geographic distribution of *juliana* is in accord with this view.

Geographic distribution.—Localities as follows;

California: Arcata, Hydesville, Scotia, Fortuna, Orick, Klamath, Dyerville, Shively, Casadero, Felton, Muir Woods, San Anselmo, Point Reyes, Fairfax, Sausalito, Muir Woods, Tiburon, Lagunitas, Mayfield, Napa County, Fieldbrook, Berkeley, Alameda, Piedmont, Contra Costa County, San Francisco, Millbrae, San Mateo, Mountain View, Crystal Lake, San Jose, Palo Alto, Los Gatos, Santa Cruz, Santa Cruz Mountains, Monterey, Carmel, Point Sal (T. Dobzhansky collector), Santa Paula, (P. H. Timberlake collection).

Remarks.—This subspecies is very common in the San Francisco region. To the north it gives numerous intergradations connecting it with the subspecies *eugenii* Mulsant (see above).

COCCINELLA HIEROGLYPHICA Linnaeus subspecies **TRICUSPIS** Kirby

Coccinella tricuspis KIRBY, Richardson's Fauna Boreali-Americana, p. 231, 1837.—CASEY, 1899, p. 90.—LENG, 1903, p. 201; 1920, p. 216.—JOHNSON, 1910, p. 59.

Body oval, more elongate than in other species of the genus *Coccinella*, strongly convex. Head with white elongate spots near the eyes, pronotum with quadrangular white marks in the anterior angles, the anterior margin of the pronotum usually white, pronotal epipleura with white quadrangular marks in the anterior angles. Mesepimera and metepimera black, mesepimera brownish only in fresh specimens. Pronotum densely and finely, elytra densely and strongly punctulate, elytra orange, with a common undulate subbasal fascia (spots $1+2+3+\frac{1}{2}+3+2+1$), and with another transverse black fascia in the posterior half of their length (spots $4+5$), not continuous across the suture. Length of the body, 3.7–4.3 mm.

Male genitalia (figs. 11, 17).—Penis short, sugar-loaf shaped, without processes or emarginations. Paramera short and thick. Basal plates wider than long. Siphon short and thick, siphonal capsule relatively very large.

Female genitalia (fig. 28).—Receptaculum seminis slender, cornu pointed at the end, ramus strongly developed. Infundibulum not dilatated at its posterior end.

I have shown (Dobzhansky, 1926) that the Siberian *Coccinella tricuspis* Kirby subsp. *mannerheimi* Mulsant is not specifically different from the European *Coccinella hieroglyphica* Linnaeus. This conclusion may be extended also to the American *tricuspis*. The genitalia of *C. tricuspis* Kirby (figs. 11, 17, 28) are completely like those of *C. hieroglyphica* (see Dobzhansky, 1926, fig. 4), and the external differences between these forms, involving the color pattern and the shape of the body, are by no means more extreme than those that are to be expected between geographic races. Thus, the species *C. hieroglyphica* inhabits the entire north of the holarctic region. The subspecies *C. hieroglyphica* lives in Europe and in western Siberia; *C. mannerheimi* occupies eastern Siberia; *C. tricuspis* occurs in Canada and northern United States; and *C. humboldtiensis* Nunenmacher inhabits the Pacific coast area of North America.

Geographic distribution.—Localities as follows:

Quebec: Quebec, Quinze Lake, Montreal.

Ontario: Lake Superior.

Manitoba: Aweme, Mile 17 on Hudson Bay Railroad.

Saskatchewan: Lebret.

Alberta: Province record.

New Hampshire: Lancaster, Mount Washington, Barnstead.

Michigan: Whitefish Point.

Minnesota: Two Harbors, Winton, Itasca Park, Minneapolis.

Montana: Bear Paw Mountains (National Museum collection).

COCCINELLA HIEROGLYPHICA Linnaeus subspecies **HUMBOLDTIENSIS** Nunenmacher

Coccinella humboldtiensis NUNENMACHER, Ent. News, vol. 23, p. 448, 1912.—LENG, 1920, p. 216.

Differs from *Coccinella hieroglyphica* Linnaeus subspecies *tricuspsis* Kirby by less elongate form of the body, finer punctulation, and by reduction of the black pigmentation of the elytra. Elytra orange with a rhomboidal black spot $\frac{1}{2}$ and without other spots, or with spots $\frac{1}{2}$, 2, 3, and 4+5, or with $\frac{1}{2}$, 4, and 5, or 4+5, or with two transverse fasciae (2+3 and 4+5), and the scutellar spot. Length of the body, 3.6–4.2 mm.

The genitalia of *C. humboldtiensis* (one male and one female were examined) are identical with those of *C. hieroglyphica tricuspsis*. Nunenmacher (loc. cit.) correctly pointed out the closeness of *humboldtiensis* to *tricuspsis*, but, in my opinion, overestimated the value of the differences discovered between them. Surprisingly enough, *humboldtiensis* possesses some similarities to the European *hieroglyphica*, which the geographically closer subspecies *tricuspsis* does not possess. The similarities are the form of the body and the shape of the elytral markings.

Geographic distribution.—Localities as follows:

Oregon: State record (Koebele collector).

California: Crescent City (F. W. Nunenmacher collector, type and cotypes), Plumas County (F. W. Nunenmacher collector), Siskiyou County (Koebele collector).

COCCINELLA UNDECIMPUNCTATA Linnaeus

Coccinella undecimpunctata LINNAEUS, Systema naturae, p. 366, 1758.—LENG, 1920, p. 216.

Oval, not strongly convex. Head with white spots near the eyes, pronotum and the pronotal epipleura with quadrangular or triangular white markings in the anterior angles. Mesepimera and metepimera white. Pronotum and elytra very densely and rather finely punctulate, elytra yellow or brick red with the 11 typical spots (fig. 30). Spots 2+3 and 4+5 fuse together forming two transverse fasciae (var. *boreolittoralis* Donisthorpe). Length of the body, 5–5.5 mm.

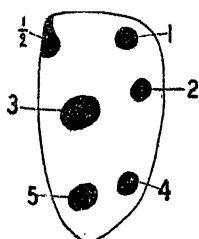


FIGURE 30.—Right elytron of *Coccinella undecimpunctata*, representing the spots constituting the typical pattern of the genus *Coccinella*. $\frac{1}{2}$, Spot $\frac{1}{2}$, or the scutellar spot; 1, the first, or humeral, spot; 2, the second, or lateral, spot; 3, the third, or discal, spot; 4, the fourth, or marginal, spot; 5, the fifth, or apical, spot

Male genitalia (figs. 12, 20).—This species may be recognized at once by the rudimentary, little chitinized siphonal capsule, and by the presence of a wide dilatation of the siphon just distal to the siphonal capsule. This dilatation is provided with an opening on the concave side of the siphon. Penis much longer than the paramera, basal plates much longer than wide, extended posteriorly into two divergent processes.

Female genitalia (fig. 29).—Receptaculum seminis long and slender, cornu pointed at the end, the ringlike sculptor rudimentary. Infundibulum short and provided with wide funnel-shaped dilatations at both ends.

Geographic distribution.—Localities as follows:

Massachusetts: Stoneham (F. A. Sherriff collector), Nahant (F. E. Blaisdell collector), Falmouth Heights (T. Dobzhansky collector).

Alaska: 4 miles north of New Rampart House (J. M. Jessup collector), 60–75 miles north of Rampart House (J. M. Jessup collector).

Remarks.—This species lives only along the sea coasts of Europe, on saline soils of Middle and Central Asia, and along the coast of the Polar Ocean from Greenland to the mouth of Yenisei. The finding of this species on the Massachusetts coast may be explained by two different hypotheses. First, it may have been introduced there from Europe. Second, it may be native there. In the latter case one may expect that it will be found also along the coasts of Nova Scotia, Newfoundland, and Labrador. The individuals from Massachusetts are quite similar to those from England and the northern coasts of Europe. The two individuals from Alaska are different from those from Massachusetts in appearance. They are larger, less convex, and have a stronger punctation. This seems to be a race the distribution of which is, as far as known, restricted to Alaska. It seems probable that *C. undecimpunctata* will be found also along the northern coast of eastern Siberia.

GEOGRAPHIC DISTRIBUTION OF SPECIES OF THE GENUS COCCINELLA

As shown above, the nearctic region is inhabited by 11 species of the genus *Coccinella*. In the palaearctic region there are at least 15 species of that genus. Six of the nearctic species are represented in this region by more than one subspecies. Furthermore, 5 species, as follows, live in both nearctic and in palaearctic regions: *transverso-guttata* Falderman, *nivicola* Menetries, *trifasciata* Linnaeus, *hieroglyphica* Linnaeus, and *undecimpunctata* Linnaeus. All these species, except perhaps *undecimpunctata*, are widely distributed in northern and eastern Siberia, in Canada, and in the northern United States. Most of them are found also in Alaska, and it is very probable that all of them will be found there when the country is studied more

thoroughly. On the other hand, only one of these species—namely, *transversoguttata*—extends its distribution to the southern limits of both nearctic and palaearctic regions; that is to say, most of the species in common to both regions are distributed only in the northern part of the holarctic region. The accompanying table shows the subdivision of the genus into groups, and the correspondence between the nearctic and the palaearctic faunas.

Group	Nearctic species	Palaearctic species
novemnotata	novemnotata Herbst. prolongata Crotch.	divaricata Olivier.
transversoguttata	transversoguttata Faldeman. johnsoni Casey.	transversoguttata Faldeman. magnopunctata Rybakow.
septempunctata	californica Mannerheim. nivicola subspecies monticola Mulsant.	septempunctata Linnaeus. nivicola Menetries. reitteri Weise. saucerrottei Mulsant.
difficilis	difficilis Crotch. suturalis Casey.	tianshanica Dobzhansky. iranica Dobzhansky.
trifasciata	trifasciata Linnaeus. hieroglyphica subspecies tricusplis Kirby.	trifasciata Linnaeus. quinquepunctata Linnaeus. hieroglyphica Linnaeus.
undecimpunctata	undecimpunctata Linnaeus.	undecimpunctata Linnaeus. pontica Dobzhansky. miranda Wollaston.

The specific diversity of the genus *Coccinella* is concentrated, in North America, in the region between the Rocky Mountains and the Pacific Ocean. There is no species, except *undecimpunctata* L., that lives in North America, and that is not found in this region. East of the Rocky Mountains there are found only five species, and these are the species common to the nearctic and palaearctic regions (see above), i. e., the widely distributed holarctic species. As mentioned above, these species are chiefly northern in their distribution. Hence, the fauna of the southeastern United States is very poor. The only species found in this region is *novemnotata* Herbst. The presence of a clear center of the specific diversity in the nearctic region has no parallel in the palaearctic. Indeed, in the palaearctic one may point to at least two separate such centers; one in the region of Mongolia, Tsaidam, and Kuku-nor and the other in the mountains of Russian Turkestan (especially the Tian-Shan system). One may also note that all the species that are widely distributed in North America form separate subspecies in the regions lying west of the Rockies.

The second outstanding feature of the distribution of *Coccinella* is the decrease of the number of species from north to south. The fauna of Mexico, though very little known, is certainly poor. In the south the genus *Coccinella* is replaced by the closely related *Cycloneda* Crotch. The center of the specific diversity of *Cycloneda* lies in Central and South America, where it, and some related genera, replace *Coccinella* completely.

KEY TO THE SPECIES OF COCCINELLA

1. Head with a broad white stripe across the front..... 2.
Head black, with two white spots near the eyes..... 3.
2. Anterior coxae with a white spot. Elytra never with transverse black fasciae. Penis extended into a triangular process, which is nearly as wide as long..... *novemnotata*.
Coxae black. Elytra frequently with transverse black fasciae. Penis extended into an acuminate process, which is much longer than wide..... *trifasciata*.
3. Mesepimera and metepimera black. Penis without emarginations or processes, sugarloaflike in shape..... *hieroglyphica*.
At least the mesepimera white. Penis of a different shape..... 4.
4. The siphonal capsule strongly chitinized. The siphon not dilated immediately beyond the siphonal capsule, and not provided in this region by a wide opening..... 5.
Siphonal capsule rudimentary, not more strongly chitinized than the rest of the siphon. Siphon strongly dilated immediately beyond the siphonal capsule, and provided with a wide opening. Mesepimera and metepimera white..... *undecimpunctata*
5. Body little convex. Elytral suture with a broad black stripe. Penis extended into a fingerlike process, the sides of which are subparallel..... *suturalis*.
Body moderately to strongly convex. Elytral suture without or with a narrow black stripe..... 6.
6. The sides of the penis deeply emarginated, its proximal part extended into a rhomboidal or triangular process..... 7.
The sides of the penis convergent distally, its proximal end extended into a more fingerlike process, acuminate at the end..... 10.
7. Anterior coxae with a white spot. Convexity of the elytra very great in the posterior third of their length. Penis extended into a rhomboidal process..... *prolongata*.
Anterior coxae black. Convexity of the elytra regular. Penis extended into a triangular process..... 8.
8. Penis extended into a process that is much longer than wide, the sides of this process strongly concave..... *transversoguttata*.
Penis extended into a broad triangular process, the sides of which are straight..... 9.
9. Body convex. Elytra spotless..... *californica*.
Body moderately convex. Elytra spotted..... *johnsoni*.
10. Body large, strongly convex. Penis gradually narrowing distally, extended into a long fingerlike process..... *nivicola*.
Body smaller, moderately convex. Penis abruptly narrowed distally, and extended into a short, acuminate process..... *difficilis*.

FEMALES

1. Mesepimera and metepimera black. Infundibulum not dilated at its posterior end..... *hieroglyphica*.
At least the mesepimera white..... 2.
2. Metepimera white..... 3.
Metepimera black or dark brown..... 8.

3. Convexity of the elytra very great in the posterior third of their length..... *prolongata*.
Convexity of the elytra regular..... 4.
4. Infundibulum not dilated on its posterior end. Elytra frequently with transverse black fasciae..... *trifasciata*.
Infundibulum dilated at both ends. Elytra usually without transverse black fasciae..... 5.
5. Head with a broad white band across the front. Infundibulum dilated more strongly at the anterior than at the posterior end..... *novemnotata*.
Head with two white spots near the eyes. Infundibulum dilated equally at both ends, or with the posterior end dilated more strongly than the anterior..... 6.
6. Infundibulum very short, equally dilated at both ends. Cornu pointed at the end, its ringlike sculpture rudimentary. Body little convex..... *undecimpunctata*.
Infundibulum very strongly dilated at its posterior end. Cornu not pointed..... 7.
7. Body strongly convex. Elytra alutaceous.. *nivicola* subspecies *alutacea*.
Body moderately convex. Elytra nonalutaceous..... *difficilis*.
8. Body little convex. Elytral suture with a broad black stripe.. *suturalis*.
Body moderately or strongly convex. Elytral suture without or with a narrow black stripe..... 9.
9. The posterior end of the infundibulum dilated much more strongly than the anterior end, and not provided with a circular constriction..... *nivicola*.
The posterior end of the infundibulum provided with a circular constriction. Both ends of the infundibulum equally strongly dilated, or the anterior end more strongly dilated than the posterior..... 10.
10. Elytra spotless..... *californica*.
Elytra spotted..... 11.
11. Body strongly convex..... *transversoguttata*.
Body moderately convex..... *johnsoni*

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ECHINODERMS FROM THE ISLANDS OF NIUAFOOU AND NUKUALOFA, TONGA ARCHIPELAGO, WITH THE DESCRIPTION OF A NEW GENUS AND TWO NEW SPECIES

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While attached to the United States Naval Eclipse Expedition to the island of Niuafouu, 1930, Lieut. Henry C. Kellers (M. C.), United States Navy, made an extensive collection of the local echinoderms.

Niuafouu, or Tin Can Island, is one of the islands in the Tonga Archipelago, and is situated between Samoa and Fiji in latitude $15^{\circ} 33' 52''$ S., longitude $175^{\circ} 37' 46''$ W. It is a volcanic island subject to more or less frequent eruptions, the last of which took place on July 25, 1929.

Lieutenant Kellers tells me that, except for a distance of about $3\frac{1}{2}$ miles, Niuafouu is practically surrounded by lava benches backed by basaltic cliffs from 70 to 100 feet in height. These benches are now covered as a result of the eruption of 1929, although in places one can see outcroppings of the old lava. They extend from 100 to 200 yards into the sea. On the outer edge they have an almost precipitous drop to the 20-fathom line, which runs out for practically a mile, where the sea floor sinks to the abysses.

Some of the benches are awash all the time and are mostly entirely covered at high tide. At low water tide pools of all sizes are found, and in these tide pools most of the collecting was done.

Lieutenant Kellers's collection includes a few specimens that were brought to him by natives from Nukualofa, the seat of government of the Tonga Group, a couple of hundred miles to the southwest of Niuafouu.

The echinoderms found at Niuafouu were species that would be expected to occur on an island situated in this general region, with a single remarkable exception. This exception is an entirely new genus of echinoids of the family Echinometridae, represented by two species, which is related to *Podophora* and also to *Heterocentrotus*.

It seems to represent *Podophora* here much as *Colobocentrotus*, also with two species, represents it in the Bonin Islands. The genus *Podophora* itself also includes two species, one of which, *P. atrata*, ranges from Zanzibar and Mauritius to the Hawaiian Islands but is very local in its occurrence and has been reported only from volcanic regions; while the other, *P. pedifera*, is definitely known only from the Tuamotus, although it has been reported from the western coast of South America and from the West Indies.

In addition to the sea urchins and sea stars listed in the following pages, the collection includes a number of ophiurans and holothurians.

I am greatly indebted to Dr. Hubert Lyman Clark, of the Museum of Comparative Zoölogy at Cambridge, Mass., for his kindness in examining for me and commenting upon the type specimen of *Zenocentrotus paradoxus*, and for his further kindness in revising the manuscript of the present paper.

Class ECHINOIDEA

Family CENTRECHINIDAE

CENTRECHINUS SETOSUS (Leske)

One small specimen.

ECHINOTRIX DIADEMA (Linnaeus)

One small specimen.

Family STOMOPNEUSTIDAE

STOMOPNEUSTES VARIOLARIS (Lamarck)

Six specimens, all but one of which are small.

Very small specimens much resemble similarly small individuals of *Echinometra oblonga*. They may easily be distinguished, however, by the milled ring at the base of the primary spines, which is only slightly developed and not sharply differentiated from the spine itself, is very fine, and is of the same color as the spine. In small examples of *Echinometra oblonga* the milled ring is strongly developed and stands out abruptly from the spine itself, is coarse, and is brilliant white, or pinkish or grayish white, in sharp contrast to the deep olive or blackish color of the spine.

The United States National Museum possesses a fine series of 83 specimens of this species collected by Owen Bryant at Pelaboean Ratoe, Wynkoops Bay, western Java.

Family ECHINIDAE

TRIPNEUSTES GRATILLA (Linnaeus)

Two specimens, one with dark and the other with whitish spines.

Family ECHINOMETRIDAE

PARASALENIA GRATIOSA A. Agassiz

Nukualofa Island. Two specimens; the larger is parasitized by a small gastropod.

The larger specimen measures 33 mm. in the longer axis and 26 mm. in the shorter. The longest spines on the longer axis are 23 mm. in length, and the longest spines on the shorter axis measure 19 mm.

The periproct is largely covered by five large plates. Of these, two are situated on the inner border of genital 1, one is on genital 2, one occupies the whole inner edge of genital 3 and about two-thirds of that of genital 4, and one occupies one-third of the inner border of genital 4 and nearly all that of genital 5. These plates are short with broadly rounded tips, and the center of the periproct is covered with eight small subequal plates.

Genital 3, though long, is very narrow, and its inner border is only about half as long as that of genitals 2 and 4. Genital 1 is short but broad, and genital 5 is the smallest, triangular, with its inner border about twice as long as that of the elongate rhombic genital 3.

Genitals 4, 5, and 1 each bear a single cylindrical or more or less club-shaped spine 2 mm. long situated near the inner edge. Genital 2 bears two spines, one diagonally behind and close to the other. Genital 3 bears two spines, one in the middle of the plate and one near the inner border. In addition to these spines, the genitals bear a few pedicellariae, some of which have jointed stalks.

Oculars II and V are insert, and ocular I is very nearly so, but oculars III and IV are very widely excluded from the periproct. Oculars II, III, and IV each bear a spine similar to the spines borne by the genitals.

Most of the spines remain cylindrical from the base to the end of the proximal third or half, from that point tapering regularly to the tip, but some taper regularly from the base, and some increase slightly in diameter as far as the end of the proximal third or half.

The test is deep black. The spines are dark olive-brown, most of them with the tips polished. The spines at and below the ambitus are somewhat lighter with longer and more prominent polished tips. The milled ring is pure white and very conspicuous.

The smaller specimen measures 21 mm. in the longer axis and 16 mm. in the shorter. The longest spines in the longer axis are 18 mm. in length, and the longest spines on the shorter axis measure 13 mm.

The periproct is completely covered by four plates. Two of these, one occupying one corner of genital 2, the whole inner edge of genital 3, and two-thirds of the inner edge of genital 4, and the other occupying one-third of the inner edge of genital 4 and the entire inner edge of genital 5, are subequal and larger than the two opposite.

The genitals are more nearly of the same size than in the other specimen. Genital 2 is the largest, followed by genital 4; genital 3 is narrower than 2 or 4 but longer; and genital 5 is longer than genital 1. The inner border of genital 3 adjoining the periproct is about half as long as the inner border of the other genitals. Genital 2 bears a cylindrical spine near the inner border, and genitals 3 and 4 have a prominent tubercle in this position but no spine; genitals 1 and 5 bear neither spines nor tubercles.

All the oculars are exsert, ocular II only slightly so, oculars I and V about twice as much so as ocular II, and oculars III and IV three or four times as much so as oculars I and V. Oculars I and III bear each a cylindrical spine, and all the oculars bear several pedicellariae.

In color this specimen resembles the other, but the spines are slightly lighter, a very few of the spines on the oral surface showing light tips with one or two very obscure subapical dark bands.

ECHINOMETRA MATHAEI (de Blainville)

Four hundred and thirty-eight specimens, all but 22 of which are more or less strongly flattened immature and young of various sizes, and are referable to *E. picta* as described by A. Agassiz and H. L. Clark.

In their final account of *E. picta* these authors said that the more the specimens on which that form is based are studied, the more doubtful it seems whether it is really distinct from *E. mathaei*. They note that in the specimens regarded as *picta* the test is distinctly flattened and is wider than usual, and the spines seem to be less crowded and are somewhat more slender than in *mathaei*, and are much less numerous on the abactinal system. The latter is distinctly larger than it is in *mathaei*, its diameter sometimes nearly equaling one-third of the test length. There is seldom more than one secondary tubercle on each genital plate. The color is dark brown for the test and light fawn color for the spines. Agassiz and Clark say that these specimens intergrade more or less com-

pletely with *mathaei* in each one of the characters, but are usually easily distinguished by the combination of all five. They remarked that such specimens occur only in material from the Hawaiian, Society, and Philippine Islands.

The specimens from Niuafouu are very variable in every feature, but those that are referable to *picta* seem simply to represent the younger or immature stages of the large ones, which are undoubtedly referable to *mathaei*.

In color the test is always dark, usually a more or less deep reddish brown, though sometimes quite black. The spines may be light olive-gray to deep olive, with long or short white or pinkish tips usually preceded by a broad and indefinite very dark band; or fawn color, uniform or with lighter or darker tips; or olive with fawn-colored tips; or olive becoming gradually darker at the tips; or whitish faintly tinged with olive or with fawn color. The milled ring is almost always pure white, but is occasionally slightly tinged with fawn color or pink.

In some specimens, apparently from quiet water, the spines are very slender and much elongated.

ECHINOMETRA OBLONGA (de Blainville)

PLATE 5, FIGURE 3; PLATE 7, FIGURE 3

One hundred and seventy-eight specimens, most of which are young of various sizes.

Young individuals of this species (pl. 5, fig. 3; pl. 7, fig. 3) are much flattened and broadened, the longer diameter being often but slightly in excess of the shorter, and the spines are slender and relatively long, and occasionally elongated. This gives them a considerable superficial resemblance to similarly small examples of *Stomopneustes variolaris*.

The specimens are all very dark in color, purplish black or very dark olive. The milled ring at the base of the primary spines is usually pure white, sometimes white tinged with purplish, pinkish, or olive.

A specimen from Puako Bay, Hawaii, recorded by A. Agassiz and H. L. Clark as *Echinometra picta* (U.S.N.M. No. 32813) seems to me to be a young example of this species.

ZENOCENTROTUS, new genus

Diagnosis.—A genus of Echinometridae in which the longer axis, which only slightly exceeds the shorter, passes through interambulacrum 4a and ambulacrum IIa; the ambulacral plates consist of 9 to 11 elements; the periproct is studded with numerous small plates;

the primary spines are circular, subtriangular, or oval in cross section, tapering, with parallel sides, or with slightly divergent sides, becoming broad and much flattened below the ambitus, much longer at the ambitus than elsewhere; the miliary spines are short, rather stout, mostly tapering and abruptly truncated at the tip, the smaller slender and club shaped; and the primary tubercles are of moderate size, one to each interambulacral plate above the ambitus, two, and later two larger and one smaller at and below the ambitus.

Genotype.—*Zenocentrotus kellersi*, new species.

Range.—Only known from Niuafoou Island, between Samoa and Fiji.

Included species.—*Zenocentrotus kellersi* and *Z. paradoxus*.

Remarks.—Except for the position of the longer axis, the test of *Zenocentrotus*, especially of *Z. paradoxus*, is very similar to that of *Echinometra vanbrunti*, in which the test is much flattened, the longer axis is often only slightly longer than the shorter, and there are numerous pore pairs—usually 7 or 8. In a specimen of *Echinometra vanbrunti* of approximately the same size as the type specimen of *Zenocentrotus kellersi*, there are 15 interambulacral and 20 ambulacral plates in each column as in that species.

The genus *Zenocentrotus*, however, appears to be most closely related to *Heterocentrotus* with which it agrees in the main features of the test, particularly the number and relative size of the primary tubercles, and the shape and structure of the poriferous areas on the oral surface. The test is, however, much more nearly circular and much more depressed than in *Heterocentrotus*. Though much more slender, the primary spines are of the same general character as those of *Heterocentrotus trigonarius*, and the young specimens of this species have a very considerable general resemblance to the species of *Zenocentrotus*, some to *Z. kellersi* (compare pl. 8, fig. 1, and pl. 3, fig. 1), and others to *Z. paradoxus* (compare pl. 8, fig. 2, and pl. 6, fig. 2). In a specimen of *Heterocentrotus trigonarius* with the test 80 mm. in the longer axis, there are 10 or 11 interambulacral and 14 to 15 ambulacral plates in each column, the plates being therefore considerably fewer than in *Zenocentrotus*.

The longer axis in *Heterocentrotus* passes through ambulacrum IVb and interambulacrum 1b, while in *Podophora* and in *Colobocentrotus* it passes through interambulacrum 4a and ambulacrum IIa as in *Zenocentrotus*. As in *Echinometra*, the test in *Podophora* and in *Colobocentrotus* varies from subcircular or rounded pentagonal to elliptical, and from much flattened to rather strongly arched. The broad poriferous zones, especially the greatly broadened poriferous areas on the oral surface, the very numerous tubercles on the interambulacral plates, and the more or less marked concavity of the

oral surface of the test along the longer axis, readily separate *Podophora* and *Colobocentrotus* from *Zenocentrotus*. The teeth of *Zenocentrotus*, it may be noticed, with their strongly beveled sides and broad flat upper surface bordered with fine rounded ridges, resemble the teeth of *Podophora* more closely than they do the teeth of the other genera.

The tube-feet resemble those of related genera, but the sucking disk is divided into almost invariably 5 (occasionally 6 and rarely 4) sectors, instead of into 4 as in *Podophora* and *Colobocentrotus* or 5 or 6 in *Heterocentrotus*.

KEY TO THE SPECIES OF THE GENUS ZENOCENTROTUS

- α^1 . Poriferous areas below much broadened, in the widest portion three-fourths the width of the adjacent portion of the interambulacral area, with the outer border strongly convex; tubercles on the interambulacral plates above the ambitus with their bases separated by less than the diameter of the tubercles; primary spines at ambitus long and mostly somewhat tapering, the spines gradually decreasing in length toward the periproct..... *kellersi*.
- α^2 . Poriferous areas below not greatly broadened, in the widest portion not more than half the width of the adjacent portion of the interambulacral area, with the outer border gently convex; tubercles on the interambulacral plates above the ambitus with their bases separated by much more than the diameter of the tubercles; spines at the ambitus less elongated and mostly increasing slightly in width distally..... *paradoxus*.

ZENOCENTROTUS KELLERSI, new species

PLATES 1-3; PLATE 4, FIGURE 1; PLATE 5, FIGURE 1; PLATE 6, FIGURE 3

Description of the type specimen.—The longer diameter of the test is 55 mm., and the shorter diameter is 47.5 mm.; the height is 19 mm.

There are 15 or 16 interambulacral and 20 ambulacral plates in each column.

The periproct (pl. 1) is irregularly oval, 4 by 3 mm.; it bears numerous small plates, which decrease in size inwardly; a very few of the larger plates bear tubercles. The madreporic plate is more than half again as large as the other genitals, which are subequal in size. It is situated in the middle half of one of the sides of the periproct delimited by the longer axis. It bears about 14 very minute tubercles, which are arranged roughly in two irregular transverse rows across the middle. The other genitals are subequal in size. Each bears 7 to 9 small tubercles, of which 2, situated on the inner margin, are much larger than the others.

All the oculars are exsert, II and III widely so, IV rather less widely, I still less widely, and V barely exsert. The oculars are very small, chevron-shaped, each with five very small tubercles.

Near the oculogenital ring each interambulacral plate bears a prominent central tubercle and a few small peripheral tubercles. These last on the third or fourth plate beyond the genital form a complete row and vary somewhat in size, those at the angles of the plates being the largest. Just above the ambitus those near the outer edge of the plate rapidly increase in size, and at the ambitus others beyond these also increase in size so that when viewed from above the inner two-thirds or half of the interambulacral areas is seen to bear two rows of large tubercles, while the outer third has four rows; and at and just below the ambitus there is a short row of somewhat smaller tubercles beyond each of the outer rows. On the actinal surface of the test these six rows rapidly converge, as a result of the broadening of the poriferous areas, and the tubercles become smaller. Two-thirds of the distance from the ambitus to the peristome the intermediate rows on each half of the interambulacra come to an end, and from that point the two central rows, and at some distance from them the two outermost rows, continue parallel to the peristome.

The ambulacral plates each bear a prominent tubercle, which slowly increases in size from the oculogenital ring to the ambitus; on the oral side of the test these tubercles rapidly decrease in size, and the two lines of tubercles converge; slightly more than halfway between the ambitus and the peristome the now very small tubercles form two parallel rows close together and run to the peristome.

There are 8 to 11 (usually 9 or 10) pore pairs in an arc both at the ambitus and near the oculars.

The oral surface of the test (pl. 2) is flat, and is only very slightly, if at all, concave in the longer axis. The peristomal area is pentagonal with double angles. The radius to the point of an angle (on the ambulacral-interambulacral border) is 11.5 mm., and the radius to the deepest (inner) portion of a poriferous area is 10 mm.

On the oral surface the poriferous areas gradually and regularly broaden to a maximum width of 5.5 mm. two-thirds of the distance from the ambitus to the peristome. From that point the outer border curves broadly downward and inward, but the inner border curves only very slightly. At their widest point the poriferous areas are about three-fourths as broad as the interambulacral areas separating them.

At the ambitus the primary spines are from 20 to 25 mm. long, the lower more or less strongly flattened, especially on the lower side. Though the lower side is slightly and evenly convex, the

upper side is less evenly rounded, being highest in the center, the cross section being a more or less low triangle with broadly rounded angles, the upper obtuse angle becoming less and less marked distally. The spines are about 2.5 mm. broad with parallel sides and an abruptly truncated tip. Just below the ambitus the spines are somewhat shorter and more flattened, and broaden slowly from the base to the distal half or two-thirds. On the oral surface they are abruptly shorter, and they rapidly decrease in size adorally, becoming at the same time much more slender.

Above the ambitus the primary spines decrease in length and become less flattened and more pointed, tapering evenly from the base to the somewhat blunted tip and being more or less regularly rounded in cross section. The spines on the third interambulacral plates below the apical disk are 13 to 15 mm. long.

Interspersed with these large spines are great numbers of much smaller spines from 3 to 5 mm. in length. These are mostly, especially along the poriferous zones, club shaped, slowly increasing in diameter to an abruptly truncated tip. A few of the larger ones have parallel sides, and some taper to a blunt tip.

The primordial ambulacral plates are rounded wedge shaped, the two of each pair with their larger ends together, forming a closed ring about the mouth. They are studded with tubercles and bear small blunt spines and numerous pedicellariae. Frequently very small nonambulacral plates are intercalated between these pairs of ambulacra.

The peristomal membrane is thickly set with very numerous very small and greatly elongated plates arranged concentrically, and it also bears a few widely scattered small rounded plates each with a median tubercle and spine and a thickened rim.

The teeth are much flattened and very thin, as in *Podophora*, with a narrow elevated rim bordering the flat upper surface on each side. In section the teeth are flattened trapezoidal.

The color is dull olive-brown with a tinge of purplish, the long spines at the ambitus lighter below and outwardly more or less strongly tinged with violet.

Type.—U.S.N.M. No. E. 2810, collected at Niuafoou by Lieut. H. C. Kellers on October 6, 1930.

Six additional specimens were collected on October 5 and 6, 1930.

Notes.—In the largest specimen (pl. 4, fig. 1; pl. 5, fig. 1) the longer diameter of the test is 60 mm., and the shorter diameter is 55 mm.; the height of the test is 25 mm. The longest spines at the ambitus are 30 mm. and the spines near the apical disk are 15 mm. long. The color is dull olive, the longest spines tinged with violet toward the tip; the spines at and below the ambitus have violet tips beneath.

In the smallest specimen (pl. 6, fig. 3) the diameter of the test is 25.5 mm. The longest spines at the ambitus are 20 mm. long and the spines nearest the periproct are 12 mm. long. The color is dull olive.

ZENOCENTROTUS PARADOXUS, new species

PLATE 5, FIGURE 2; PLATE 6, FIGURES 1, 2; PLATE 7, FIGURES 1, 2

Description of the type specimen.—The longer diameter of the test is 37 mm., and the shorter diameter is 33 mm.; the height is 13.5 mm.

There are 13 or 14 interambulacral and 16 ambulacral plates in each column.

The large spines at the ambitus (pl. 5, fig. 2; pl. 6, figs. 1, 2) are flatter and more broadened than in *Z. kellersi*, all of them increasing slightly in width distally or having parallel sides; none taper distally. On the apical surface the spines very rapidly decrease in size above the ambitus, almost immediately becoming short, and mostly very short, the longest not more than 7 or 8 mm. in length. About the peristome (pl. 7, fig. 2) there is in each interambulacral area a group of usually 4 long, slender, narrowly spatulate spines 4–5 mm. long which stand out rather conspicuously because of their length from the other spines on the oral surface. In *Z. kellersi* (pl. 4, fig. 1) the spines in this position are not noticeably different from those behind them.

The oculars (pl. 6, fig. 1) are larger than in the type specimen of *Z. kellersi*, with I and V more fully exsert; each bears from 1 to 3, usually 3, very small tubercles.

The tubercles on the interambulacral and ambulacral plates are relatively smaller than in *Z. kellersi*, and are more widely separated.

There are 10 or 11, usually 11, pore pairs in an arc.

On the oral surface (pl. 7, fig. 1) the poriferous zones are less broadened, being where they are widest about half as broad as the interambulacral areas separating them. Their outer margin is much less strongly curved than in *Z. kellersi*, and the tubercles in the two ambulacral rows between the poriferous zones are smaller at the ambitus and decrease more gradually in size.

Type.—U.S.N.M. No. E. 2813, collected at Niuafoou by Lieut. H. C. Kellers on September 20, 1930.

Thirteen additional specimens were collected on September 19 and 20 and on October 6, 1930.

HETEROCENTROTUS TRIGONARIUS (Lamarck)

PLATE 4, FIGURE 2; PLATE 8

Twenty-seven specimens. In the largest specimen the longer diameter of the test is 55 mm., and the longest spines are 75 mm. long.

In the smallest the longer diameter of the test is 25 mm., and the longest spines are 20 mm. long.

These specimens, most of which are small, show very great diversity. In the largest (pl. 8, fig. 1) the primary spines near the center of the apical surface are very stout at the base, regularly tapering and conical, and up to 57 mm. long. Toward the ambitus the primary spines gradually increase in length, reaching a maximum of 75 mm., and at the same time gradually become rounded trigonal with somewhat blunted tips. The secondary spines for the most part are stout and sharp pointed, but those on the apical disk are very short and abruptly truncated.

In three other specimens the primary spines are rather slender, tapering, and trigonal. In one there are a few short and abruptly truncated spines on and about the periproct and in the upper portions of the ambulacral areas; in another short and irregularly truncated spines are rather numerous on and about the apical system; while in the third such spines are very numerous.

In all the other specimens (*cf.* pl. 4, fig. 2; pl. 8, fig. 2) the primary spines are thickened, more or less club shaped, with abruptly rounded tips. In some the large primaries of the ambulacral areas run up almost to the oculars, while in others a large portion of the ambulacral areas on the apical surface is covered simply with short abruptly truncated spines, which in extreme cases may extend nearly to the ambitus as in *H. mammillatus*.

Class ASTEROIDEA

Family ARCHASTERIDAE

ARCHASTER TYPICUS Müller and Troschel

Nukualofa Island. One specimen.

LINCKIA LAEVIGATA (Linnaeus)

Seventeen large specimens.

LINCKIA MULTIFORA (Lamarck)

Nukualofa Island. Two small specimens.

EXPLANATION OF PLATES

PLATE 1

Zenocentrotus kelleri, the type specimen, Niuafoou, October 6, 1930 (U.S.N.M. No. E. 2810), apical view, $\times 2$. Oral view of the same specimen shown in Plate 2.

PLATE 2

Zenocentrotus kelleri, the type specimen, Niuafoou, October 6, 1930 (U.S.N.M. No. E. 2810), oral view, $\times 2$. Apical view of the same specimen shown in Plate 1.

PLATE 3

- FIGURE 1. *Zenocentrotus kelleri*, a medium-sized specimen, Niuafoou, October 6, 1930 (U.S.N.M. No. E. 2970), apical view, natural size.
2. *Zenocentrotus kelleri*, the same specimen, oral view, natural size.

PLATE 4

- FIGURE 1. *Zenocentrotus kelleri*, the largest specimen, Niuafoou, October 6, 1930 (U.S.N.M. No. E. 2811), oral view, natural size. Apical view of the same specimen shown in Plate 5, Figure 1.
2. *Heterocentrotus trigonarius*, Niuafoou, October 6, 1930 (U.S.N.M. No. E. 2918), oral view, natural size. Apical view of the same specimen shown in Plate 8, Figure 2.

PLATE 5

- FIGURE 1. *Zenocentrotus kelleri*, the largest specimen, Niuafoou, October 6, 1930 (U.S.N.M. No. E. 2811), apical view, natural size. Oral view of the same specimen shown in Plate 4, Figure 1.
2. *Zenocentrotus paradoxus*, Niuafoou, September 20, 1930 (U.S.N.M. No. E. 2814), apical view, natural size. Oral view of the same specimen shown in Plate 7, Figure 2.
3. *Echinometra oblonga*, young, Niuafoou, September 13, 1930 (U.S.N.M. No. E. 2897), apical view, $\times 2$. Oral view of the same specimen shown in Plate 7, Figure 3.

PLATE 6

- FIGURE 1. *Zenocentrotus paradoxus*, the type specimen, Niuafoou, September 20, 1930 (U.S.N.M. No. E. 2813), apical view, $\times 2$. Oral view of the same specimen shown in Plate 7, Figure 1.
2. *Zenocentrotus paradoxus*, Niuafoou, September 20, 1930 (U.S.N.M. No. E. 2814), apical view, natural size.
3. *Zenocentrotus kelleri*, the smallest specimen, Niuafoou, October 6, 1930 (U.S.N.M. No. E. 2970), apical view, $\times 2$.

PLATE 7

- FIGURE 1. *Zenocentrotus paradoxus*, the type specimen, Niuafoou, September 20, 1930 (U.S.N.M. No. E. 2813), oral view, $\times 2$. Apical view of the same specimen shown in Plate 6, Figure 1.
2. *Zenocentrotus paradoxus*, Niuafoou, September 30, 1930 (U.S.N.M. No. E. 2814), oral view, natural size. Apical view of the same specimen shown in Plate 5, Figure 2.
3. *Echinometra oblonga*, Niuafoou, September 13, 1930 (U.S.N.M. No. E. 2897), oral view, $\times 2$. Apical view of the same specimen shown in Plate 5, Figure 3.

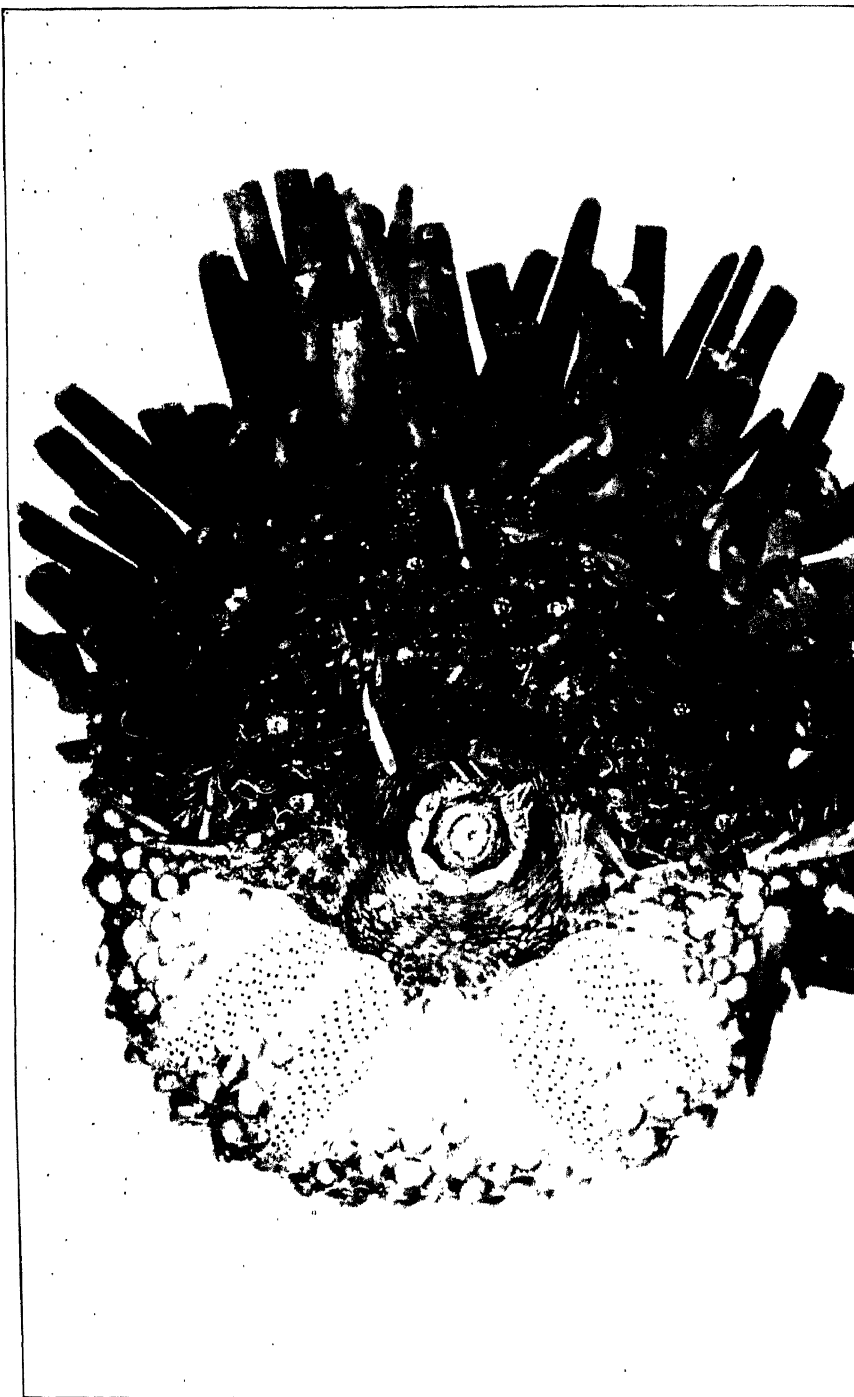
PLATE 8

- FIGURE 1. *Heterocentrotus trigonarius*, Niuafoou, August 31, 1930 (U.S.N.M. No. E. 2908), apical view, natural size.
2. *Heterocentrotus trigonarius*, Niuafoou, October 6, 1930 (U.S.N.M. No. E. 2918), apical view, natural size. Oral view of the same specimen shown in Plate 4, Figure 2.



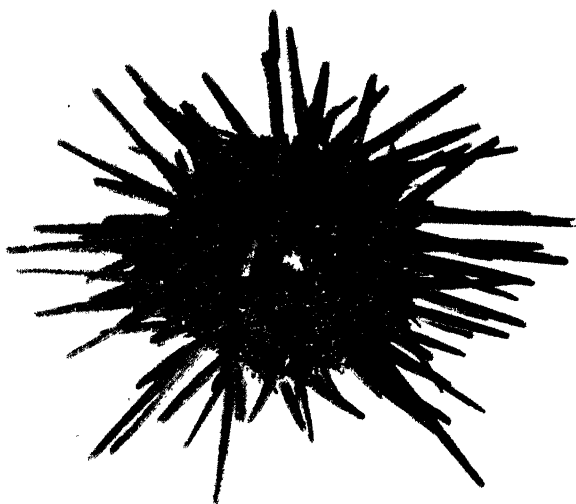
ZENOCENTROTUS KELLERSI

FOR EXPLANATION OF PLATE SEE PAGE 11

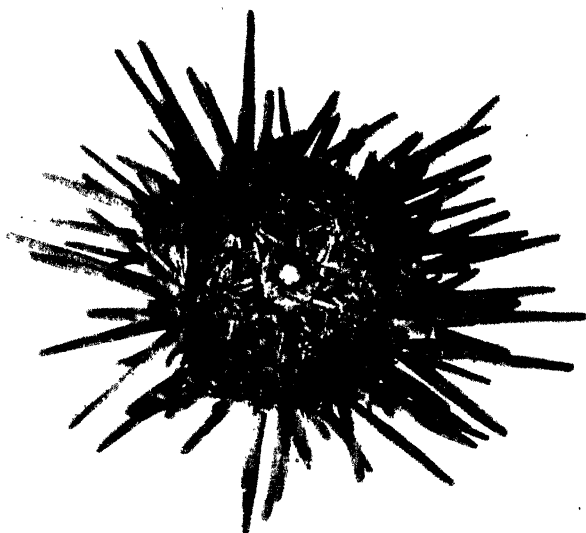


ZENOCENTROTUS KELLERSI

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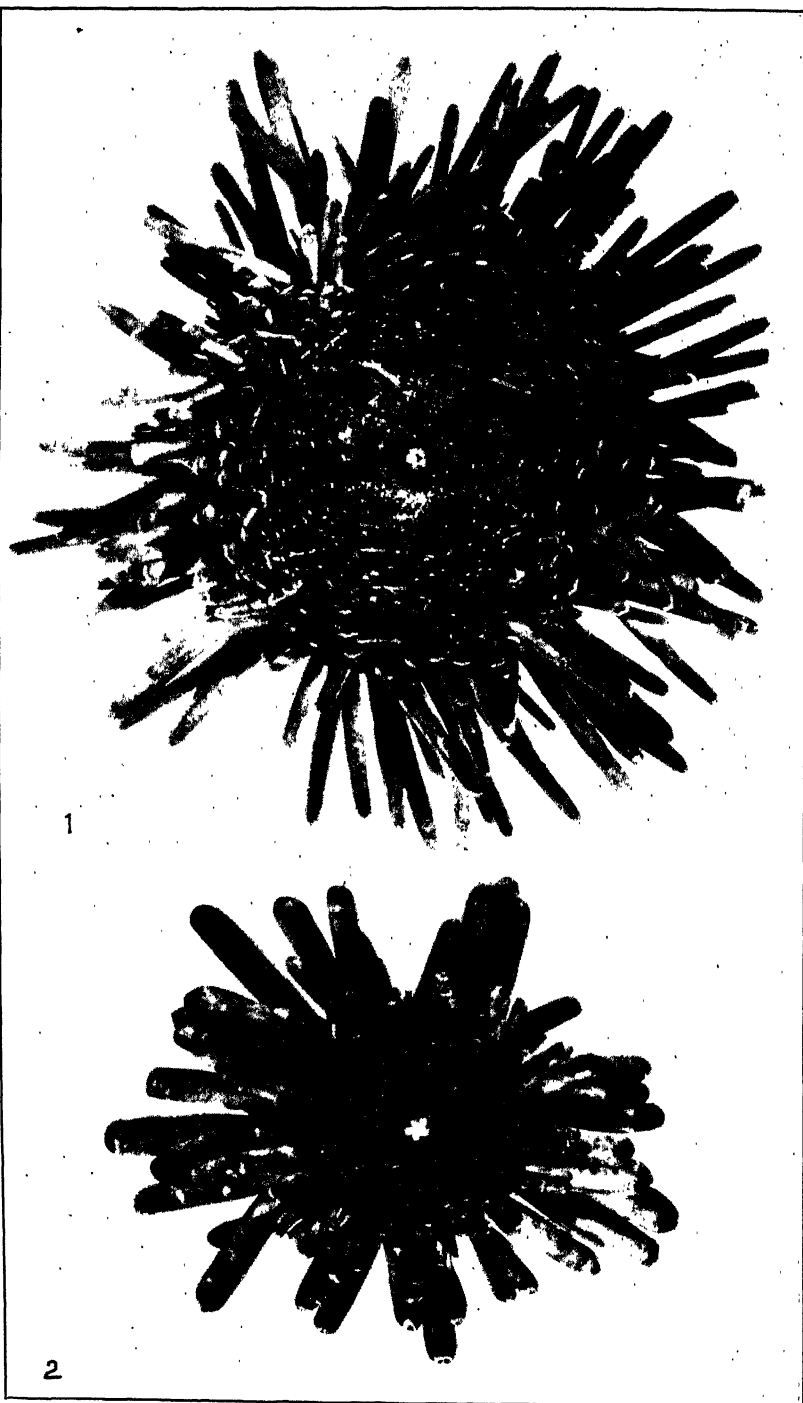


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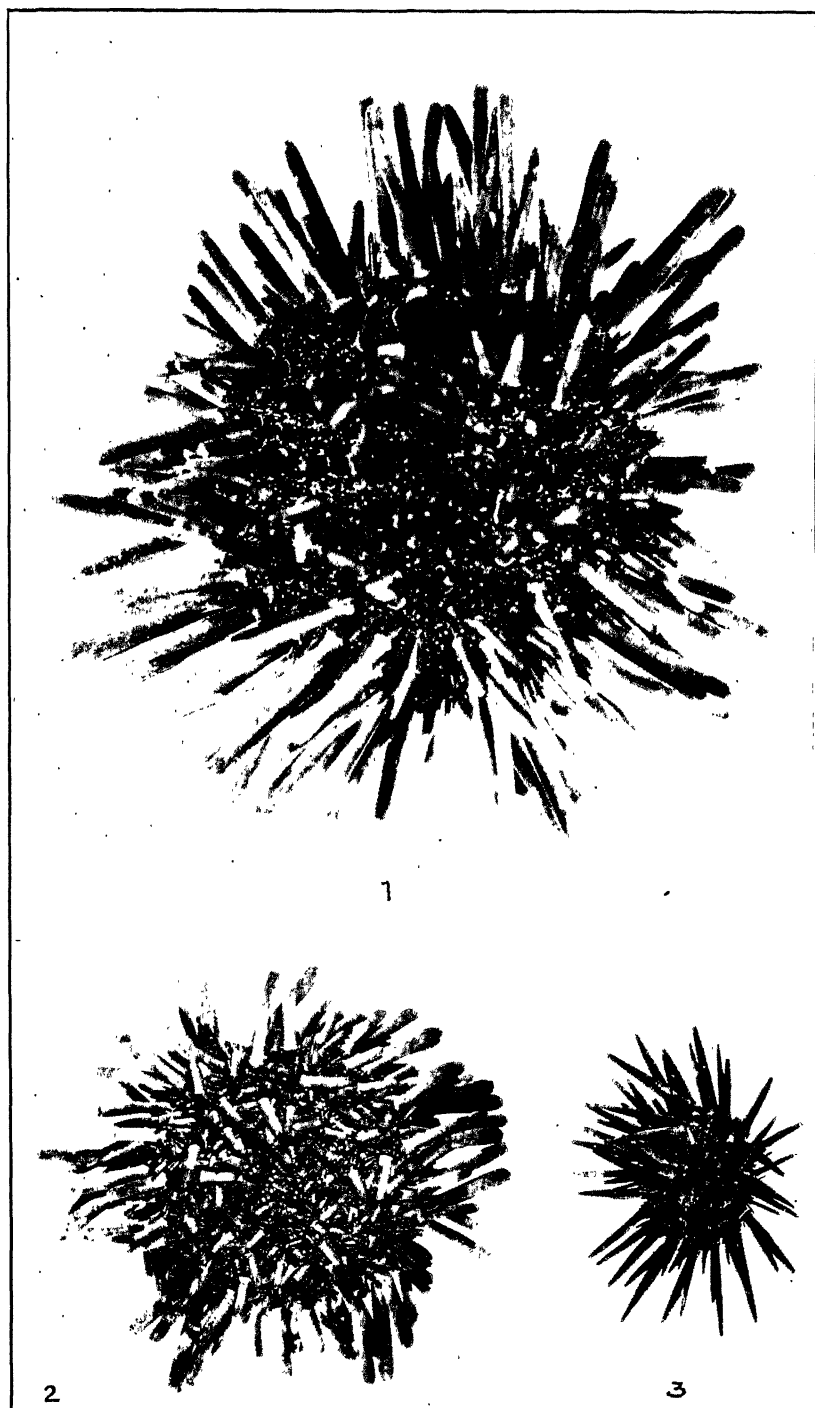


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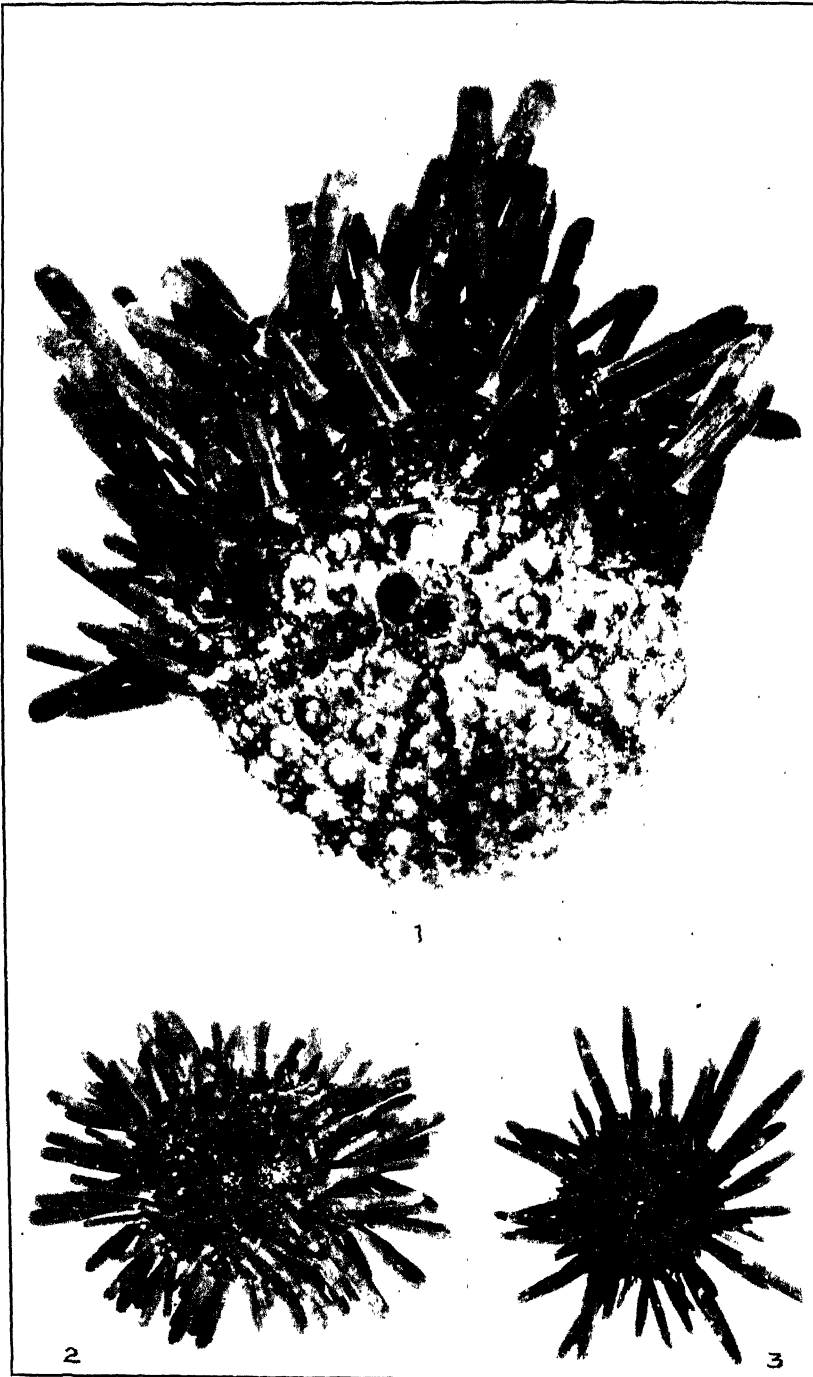
ZENOCENTROTUS KELLERSI
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ZENOCENTROTUS KELLERSI AND HETEROCENTROTUS TRIGONARIUS
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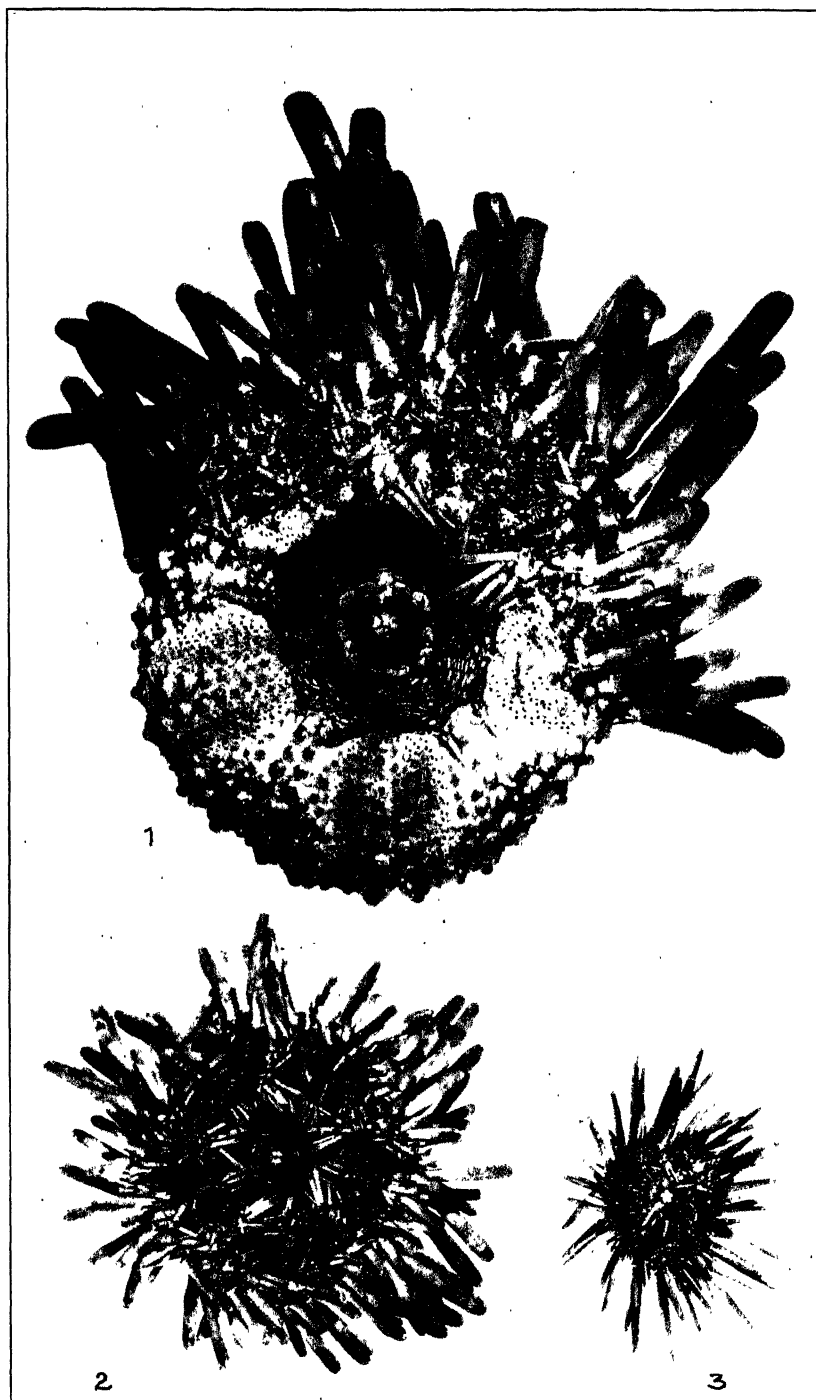


ZENOCENTROTUS KELLERSI, Z. PARADOXUS, AND ECHINOMETRA OBLONGA
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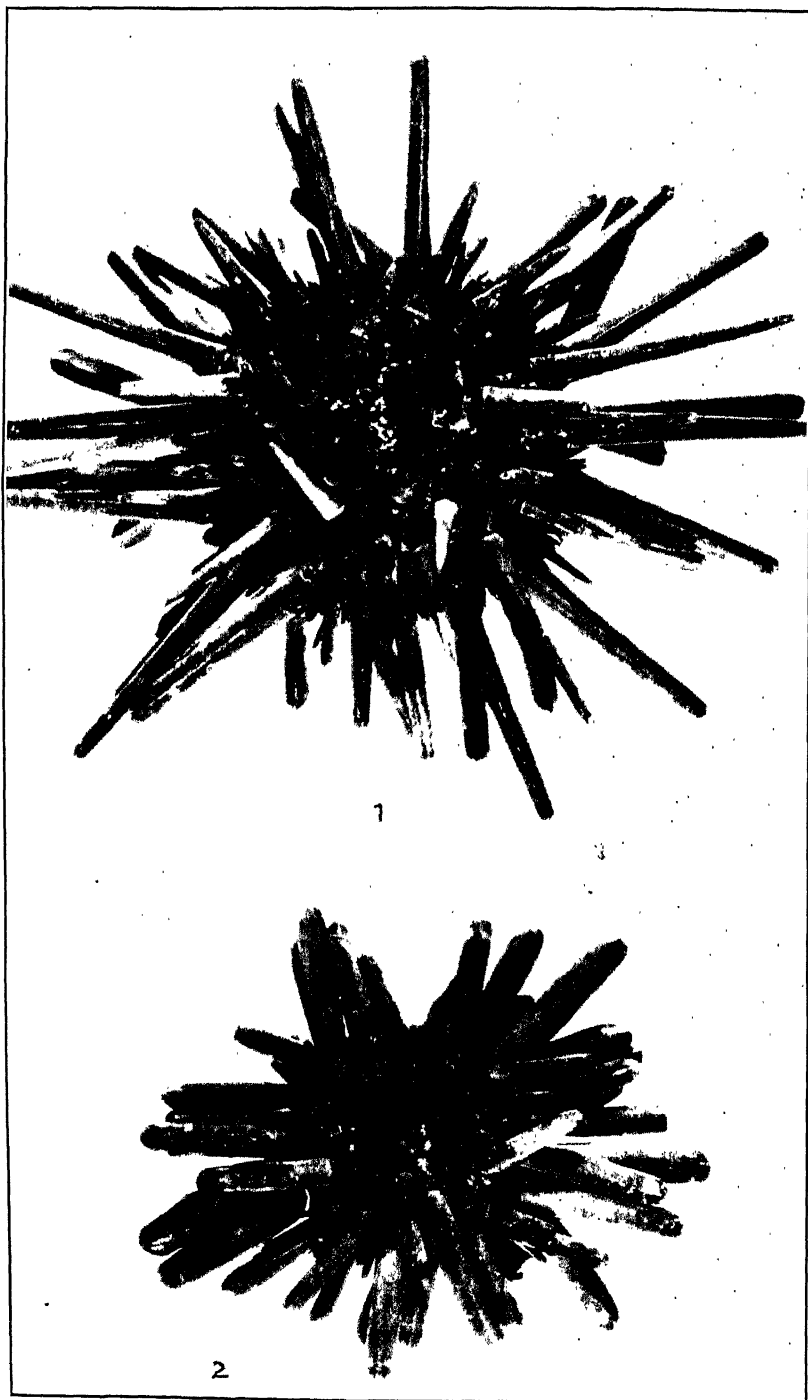
ZENOCENTROTUS PARADOXUS AND Z. KELLERSI

FOR EXPLANATION OF PLATE SEE PAGE 12.



ZENOCENTROTUS PARADOXUS AND ECHINOMETRA OBLONGA

FOR EXPLANATION OF PLATE SEE PAGE 12



HETEROCENTROTUS TRIGONARIUS
FOR EXPLANATION OF PLATE SEE PAGE 12.

THE FISHES OBTAINED BY THE PINCHOT SOUTH SEAS EXPEDITION OF 1929, WITH DESCRIPTION OF ONE NEW GENUS AND THREE NEW SPECIES

By HENRY W. FOWLER

Academy of Natural Sciences of Philadelphia

The fishes reported upon in this paper form the collection obtained by Gov. Gifford Pinchot's expedition of 1929 to the South Seas. Briefly, the course of this expedition was across the Caribbean Sea, through the Canal Zone, thence to Cocos Island and the Galapagos and Marquesas Groups, and finally to Tahiti, Society Islands. Most of the fishes were obtained in the Galapagos and Marquesas Groups, largely through Dr. A. K. Fisher, of the United States Biological Survey. Dr. Henry A. Pilsbry, of the Academy of Natural Sciences of Philadelphia, also accompanied the expedition and obtained a number of fishes forwarded to Philadelphia. In the following pages I have mentioned these materials as in the academy, as it may be understood that otherwise the specimens are in the United States National Museum.

The collections include 69 determined species, many of which are interesting or valuable records for distribution. The following are described as new: *Benthosema pinchoti*, new species; *Ophioblennius pinchoti*, new species; *Giffordella*, new genus (Blenniidae); *Giffordella corneliae*, new species.

Family EULAMIIDAE

EULAMIA GALAPAGENSIS (Snodgrass and Heller)

One fine young example, 565 mm. long, an embryo from a female 2,592 mm. long, taken in Chatham Bay, Cocos Island, June, 1929.¹ Of the large female, portions of the left pectoral fin, upper teeth, and piece of skin are preserved. The teeth are broadly triangular, their outer edges slightly concave, and all edges finely serrate.

¹ All dates herein are 1929.

Another example, evidently the present species, taken from Conway Bay, Indefatigable Island, Galapagos, June 24. Represented by a section of jaw with four teeth, tip of pectoral, and portion of skin, and agrees with the Chatham Bay material.

A third specimen taken in Wreck Bay, Chatham Island, July 6. Of the large female, portions of the left pectoral fin, upper preserved.

EULAMIA sp.?

From 70 miles south of Panama, August 15. Piece of fin, teeth, and other parts.

Family MOBULIDAE

MANTA BIROSTRIS (Walbaum)

The following items, all portions or materials from several of these great rays, are preserved; detailed observations under the name "sea bats" are well set forth in Governor Pinchot's recent volume on the expedition, To the South Seas:

Tail without any trace of spine, piece of skin, and other parts. Length of tail, 1,400 mm. All from Ua Huka Island, Marquesas Islands, September 20.

Three portions from specimen taken at Ua Huka, September 25. Head with rolled cephalic fin 350 mm. long, directed forward. Portion of end of pectoral fin. Short ventral fin with clasper, latter not reaching hind fin edge.

Also tail and portions of skin of example from Ua Huka, September 25. With this, bottle of stomach contents, mostly necton or copepod crustaceans.

Piece of skin of example caught at entrance to Obi Tufa Bay, Eiro Island, Marquesas Islands.

Jaws of a large example as dry preparation, without exact data. Upper edentulous jaw 920 mm. wide. Lower jaw 1,200 mm. wide, dentary area 610 mm. as measured over surface. Teeth estimated in 416 transverse rows, in which there are 7 to 10 short truncate or obtuse small teeth, the crown of each from nearly level to convex.

In the academy, gill arches from a large example from Shavay Bay, Ua Huka, Marquesas Islands, September 21.

Family CLUPEIDAE

HARENGULA PUNCTATA (Rüppell)

One in the academy, 74 mm. long, from Taiohae, Nukuhiva, Marquesas Islands. Taken in tide pools, September 26. Maxillary reaches one-fourth in eye. Gill rakers 23+35, finely lanceolate.

Scales 40 in median lateral series to caudal base, adherent; 12 transversely. Abdominal serrae 16+10. A. II, 18, 1. Back brilliant steel blue to violet-black, sides and lower surfaces bright silvery white. Iris white. Fins pale, front terminal part of dorsal dark gray. Caudal with lobes grayish terminally.

One in the National Museum, same data as above, 39 mm.

Not previously reported from the Marquesas.

OPISTHONEMA LIBERTATIS (Günther)

Three examples, 158 to 160 mm., from Conway Bay, Indefatigable Island, Galapagos, June 24.

Family CONGRIDAE

LEPTOCEPHALUS sp.?

Two larval eels, 61 to 65 mm., in the academy, taken at the surface of Gardner Bay, Hood Island, Galapagos, June 30.

Three larval eels, 102 to 138 mm., in the National Museum from Black Beach Anchorage, Charles Island, Galapagos, June 27.

Family OPHICHTHYIDAE

MYRICHTHYS MACULOSUS (Cuvier)

One from the gullet of a cormorant at Narborough Island, Galapagos Islands, obtained by Dr. A. K. Fisher, August 25. This a damaged specimen 440 mm. long.

LETHARCHUS PACIFICUS Osburn and Nichols

Two, 204 to 290 mm. long, from Gardner Bay, Hood Island, June 30. Also one in the academy, same data, 140 mm.

CALLECHELYS MARMORATUS (Bleeker)

One, 310 mm. long, from Black Beach Anchorage, Charles Island, Galapagos, June 27. Interesting as new for the Galapagos. Its former distribution from Mauritius to the East Indies and Hawaii.

Family ECHIDNIDAE

LYCODONTIS NUDIVOMER (Günther)

One, 600 mm. long, from Ua Huka, Marquesas Islands, September 26. Teeth all entire in jaws, though broad, well compressed, and uniserial. Palate toothless, except short depressible tooth anteriorly.

Coloration largely blackish brown, with imperfect, variable, whitish reticulating lines, most distinct over under surfaces. The pattern of coloration somewhat approaches *Gymnothorax hilonis* Jordan and Evermann, and again it also suggests that of *Lycodontis undulata* (Lacépède).

Family SYNODONTIDAE

SYNODUS JAPONICUS (Houttuyn)

Five, 55 to 60 mm., from Black Beach Anchorage, Charles Island, Galapagos, June 27.

In the academy, five from the surface of Gardner Bay, Hood Island, June 30, and one from Charles Island, June 27, all in Galapagos Group. Former 23 to 60 mm., latter 59 mm. All are scaleless, with 10 dark saddles on back, the last at caudal base.

Fourteen, 28 to 40 mm., in the National Museum, from Nukuhiva, Marquesas Islands, September 25.

Family MYCTOPHIDAE

DIAPHUS AGASSIZII Gilbert

In the academy, 86 examples, 60 to 74 mm., from Taiohae, Nukuhiva, Marquesas Islands. Obtained by light over side of boat at night, September 26.

In the National Museum, 72 examples, 57 to 72 mm., September 29, also from Taiohae.

BENTHOSEMA PINCHOTI, new species

FIGURE 1

Description.—Depth $3\frac{7}{8}$; head $2\frac{7}{8}$, width $2\frac{1}{8}$. Snout $7\frac{1}{8}$ in head measured from snout tip; eye $2\frac{4}{8}$, greatly exceeds snout or interorbital; maxillary reaches little beyond eye, terminal expansion one-third of eye, well sheathed above by cheek, length $1\frac{3}{8}$ in head from snout tip; teeth in jaws minutely villiform, in narrow bands, visible with closed jaws; mandible but slightly protrudes; interorbital $4\frac{1}{8}$ in head from snout tip, nearly level. Gill rakers about 6+21, slender, lanceolate, $12\frac{1}{8}$ in eye or twice gill filaments.

Anteorbital luminous organ veiled, though about one-half pupil; mandibular photophores veiled, 3 on each mandibular ramus, 2 operculars close behind lower opercular edge and upper double; pectorals 5, first veiled by gill covers; 2 subpectorals, anterior veiled by gill cover and upper at lower pectoral fin base; suprapectoral high, at inception of lateral line; upper postpectoral slightly above level of pectoral origin though close below lateral line; front supraventral below upper subpectoral, postero-supraventral higher, level with first supraanal; 3 ventrals; 6 anteroanals, then 4 postero-

anals; 2 supraanals with uppermost on lateral line; 1 posterolateral on lateral line; 2 precaudals, posterior close below lateral line.

Scales mostly all fallen, about 28 (pockets) in lateral line to caudal base and 2 more on latter; 3 above, 4 below.

D. π , 12, first ray $1\frac{3}{5}$ in total head length, adipose fin slender, midway between hind dorsal basal end and caudal base, length $2\frac{1}{5}$ in eye; A. π , 16, first branched ray $2\frac{1}{5}$ in total head length; caudal (damaged) estimated about $1\frac{1}{4}$; least depth of caudal peduncle 3; pectoral $1\frac{3}{5}$, rays 16; ventral $2\frac{4}{5}$, rays 8.

Scales silvery, with metallic steel-blue reflections. Iris silvery white. Body and scale pockets where scales have fallen mostly dusky to blackish. Luminous organs silvery white. Fins all whitish, adjacent body basally blackish.

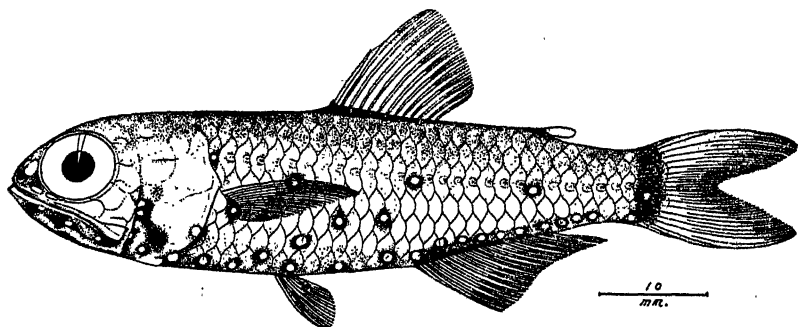


FIGURE 1.—*Benthosema pinchotti*, new species. U. S. N. M. No. 91823 (type)

Type.—U.S.N.M. No. 91823, collected near light, Nukuhiva, Marquesas Islands. September 25, 1929. Length, 71 mm.

Diagnosis.—Distinguished in its genus chiefly by the presence of the suprapectoral photophore at the origin of the lateral line.

Named for Gov. Gifford Pinchot.

Family POECILIIDAE

GAMBUSIA NICARAGUENSIS Günther

Seven, 21 to 49 mm., Colon, Panama.

GAMBUSIA CAYMANENSIS Regan

Eight, 10 to 44 mm., Grand Cayman, West Indies, April 17.

Family BELONIDAE

STRONGYLURA INDICA (Le Sueur)

One caught in entrance to Taipi Bay, Nukuhiva, Marquesas Islands, September 26. Head 315 mm. long.

Family HEMIRAMPHIDAE

HEMIRAMPHUS UNIFASCIATUS Ranzani

Two, in academy, 120? to 200 mm., from Charles Island, Galapagos. Taken at light at anchorage. Lower gill rakers, 19 to 21.

HEMIRAMPHUS ROBERTI Valenciennes

Two, 137 to 154 mm., from Black Beach Anchorage, Charles Island, Galapagos, June. Depth from mandible tip 9; mandible tip from upper jaw tip longer than rest of head. D. $\bar{1}$, 14 or 13; A. $\bar{1}$, 15.

HEMIRAMPHUS PACIFICUS Steindachner

One, about 71 mm. long, from about light, Nukuhiva, Marquesas Islands, September 25.

HEMIRAMPHUS BRASILIENSIS (Linnaeus)

One, 368 mm., from Hivaoa, Marquesas Islands, September 12.

Family EXOCOETIDAE

FODIATOR ACUTUS (Valenciennes)

One, about 144 mm., from Indefatigable Island, Galapagos, June 21. New for the Galapagos Group.

EXOCOETUS VOLITANS Linnaeus

One, 248 mm. long, from 1,000 miles west of Galapagos Islands, latitude 3° S., longitude 108° W., September 1.

One, 193 mm., from latitude 2° 10' N., longitude 86° W.

One, 188 mm., from 100 miles east of Tahiti, Society Islands, October 9.

CYPSELURUS RUBESCENS (Rafinesque)

One, 285 mm., from the Pacific, latitude 7° S., longitude 124° W., September 7.

CYPSELURUS ATRISIGNIS Jenkins

One, 381 mm., from north of Tuamotu Islands, September 30. Predorsal scales 38 from occiput to dorsal. D. $\bar{1}$, 11, $\bar{1}$; A. $\bar{1}$, 10, $\bar{1}$.

CYPSELURUS BAHIENSIS (Ranzani)

One, 405 mm., from Cocos Island, June 6. D. $\bar{1}$, 13, $\bar{1}$; A. $\bar{1}$, 9, $\bar{1}$.

One in the academy, 385 mm., from Chatham Bay, Cocos Island. Same fin formula as above specimen.

CYPSELURUS CALLOPTERUS (Günther)

One, about 270 mm., from 90 miles south of Panama, July 17. D. 1, 11, 1; A. 1, 6, 1, both fins uniformly pale. Pectoral dark gray, thickly marked with round black spots, none larger than pupil. Ventral pale or whitish, grayish on outer half terminally, this area also with about four rows of black spots.

Family SYNGNATHIDAE

HIPPOCAMPUS STYLIFER Jordan and Gilbert

One, 48 mm., from Key West, Fla. Rings with quite numerous and elongate points or spines.

COELONOTUS PLATYRHYNCHUS (Duméril)

FIGURE 2

Description.—Depth $23\frac{1}{2}$ to $24\frac{1}{4}$; head 8 to 9, width $3\frac{1}{2}$ to $3\frac{3}{5}$. Snout $2\frac{1}{5}$ to $2\frac{1}{4}$ in head from snout tip, width $1\frac{3}{5}$ to $1\frac{2}{3}$ its length; eye 5 to $5\frac{1}{5}$ in head from snout tip, $2\frac{1}{5}$ to $2\frac{1}{4}$ in snout, little greater than interorbital; mouth with very short cleft, broad, superior terminally; interorbital $5\frac{3}{4}$ to 6 in head from snout tip, nearly level. Gill opening small.

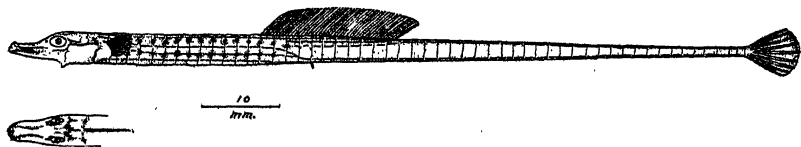


FIGURE 2.—*Coelonotus platyrhynchus* (Duméril)

Rings 17 or 18 + 35 to 37. Upper keel of trunk and tail continuous and joined with auxiliary short keel starting on last trunk ring superiorly and finally approximating opposite base of last dorsal ray; median lateral trunk keel slopes down on last 3 trunk rings or opposite front of dorsal and continues on tail as lower caudal keel; lower trunk keel approximates slightly with its fellow at vent to buttress abdominal brood organ, which is well marked in male.

D. 40 to 45, extends on 4 trunk rings and 7 caudal rings, higher than body depth below or fin height $2\frac{1}{5}$ in head; caudal fanlike, $1\frac{3}{5}$; pectoral 3 to 4, rays 15 or 16; anal very small, about half of eye.

Pale brown, below to uniform whitish. Iris gray, evidently silvery in life. At junction of each trunk ring above and below median lateral keel a small black ocellus, thus forming 2 lateral rows. Caudal brownish, other fins transparent. Black spots variable as in one example several before and behind pectoral base.

Three from Ua Huka, Marquesas Islands. September 23. Length, 105 to 108 mm.

Originally described from Nukuhiva in 1870, this species has not since been obtained there. Duncker has more recently reported it from New Pomerania in the Bismarck Archipelago. These are the only localities from which it is known.

Family MUGILIDAE

MUGIL THOBURNI Jordan and Evermann

From tide pool at Eiao, Marquesas Islands, 67 examples, 39 to 60 mm. long, September 28. No adipose eyelids. Scales 38 in median lateral series to caudal base and 4 more on latter. Soft dorsal and anal largely with small scales. Pectoral with pointed axillary scale. A. III, 9. Back slate gray, iris and below silvery white. Dorsals and caudal dark gray, other fins paler. Pectoral base about origin dusky.

Three, 19 or 20 mm., in National Museum, from Hivaoa, Marquesas, September 13, probably this species.

Not previously reported from Oceania.

MYXUS HARENGUS Günther

One, 53 mm., from Black Beach Anchorage, Charles Island, Galapagos Group, June 27. Scales 44 in lateral series to caudal base and 3 more on latter. D. IV-I, 9, 1; A. II, 10, 1. Back neutral dusky. Sides and lower surface, including iris, silvery white. Dorsals and caudal grayish. Pectoral pale, with dusky base, black in axilla. Lower fins white.

NEOMYXUS CHAPTALII (Eydoux and Souleyet)

Three, 100 to 123 mm., Marquesas Islands, September.

Three, 115 to 121 mm., Ua Huka, Marquesas Islands, September 24.

Two, 100 to 120 mm., Ua Huka, September 24.

Three, 42 to 135 mm., Taiohae tide pools, Nukuhiva, Marquesas Islands, September 26, in the academy.

CESTRAEUS PLICATILIS Valenciennes

One, 39 mm. (caudal broken), from Taiohae, Nukuhiva, Marquesas Islands, September 26. Back generally metallic blue-black, sides and lower surface silvery white, with steel-blue shade. Iris and fins all whitish. Spinous dorsal with dusky shade forward. Bases of soft dorsal and caudal slate black.

Family SCOMBRIDAE

EUTHYNNUS PELAMIS (Linnaeus)

One, 478 mm., from off Papeete, Tahiti, October 19.

THUNNUS THYNNUS (Linnaeus)

One, from near Obi, Tufa Bay, Eiao, Marquesas Islands, September 28. Head 366 mm. long. Snout $2\frac{2}{5}$ in head; eye $6\frac{2}{3}$, 3 in snout, 3 in interorbital; maxillary reaches opposite $\frac{2}{3}$ of eye, expansion $1\frac{1}{2}$ in eye, with groove at lower expansion angle $1\frac{1}{2}$ in expansion; maxillary length 2 in head.

One, from Ua Huka, Tufa Bay, September 22. Pieces of body.

One from near Obi, Tufa Bay, September 28. Pieces of body.

Family CARANGIDAE

CARANX SEXFASCIATUS Quoy and Gaimard

Two in the academy, 129 to 148 mm., from Conway Bay, Indefatigable Island, Galapagos Group, June 24.

Two in National Museum, 145 and 128 mm. long. Same data.

One, 120 mm., from Cocos Island, June 6.

Four, 88 to 110 mm., from Hivaoa, Marquesas Group, September 13.

CARANX LATUS Agassiz

One in the academy, 44 mm., from Key West, Fla., April 10.

A single example, 42 mm. long, in the National Museum. Same data as above.

VOMER SETIPINNIS (Mitchill)

One in the academy, 183 mm., from Balboa, Canal Zone, August 8.

Family DULEIDAE

DULES MARGINATUS Cuvier

Scales about 35 or 36 in lateral line to caudal base. D. X, 11. A. III, 11. Generally brilliant silvery white, back with leaden hue. Iris silvery white. Fins all whitish, cluster of blackish dots at caudal base, especially medially. Caudal terminally with some gray dots. Five, 28 to 30 mm., Nukuhiva, Marquesas Islands. September 25.

Family SERRANIDAE

SERRANUS MERRA (Bloch)

One example, 66 mm., from Ua Huka, Marquesas Group, September 24.

MYCTEROPERCA OLFAX (Jenyns)

One, 690 mm., from Port Charles Bay, Charles Island, Galapagos Group, June 28; yellow.

Family LUTJANIDAE**LUTJANUS MONOSTIGMA** (Cuvier)

Four examples, 94 to 160 mm., from tide pools, Ua Huka, Marquesas Islands, September 24. All have the black blotch on the lateral line, opposite front of soft dorsal, smaller than eye.

One in the academy, 188 mm. long, from Taiohae, Nukuhiva, Marquesas Islands, in tide pools, September 26.

XENOCYS JESSIAE Jordan and Bollman

One example, 220 mm., from Black Beach Anchorage, Galapagos Group, June 27.

Two, 190 to 210 mm., from Charles Island, Galapagos Group, in the academy, June 17.

Family MULLIDAE**UPENEUS VITTATUS** (Forskål)

Six, 140 to 182 mm., from Hivaoa, Marquesas Islands.

In the academy, 4 examples, 150 to 175 mm., from stream at Atuona Bay, Hivaoa, September 12.

Family GERRIDAE**EUCINOSTOMUS CALIFORNIENSIS** (Gill)

One example, 144 mm., from Conway Bay, Indefatigable Island, Galapagos Group, June 24.

Family HEPATIDAE**HEPATUS TRIOSTEGUS** (Linnaeus)

Fourteen, 65 to 110 mm., from Ua Huka, Marquesas Islands, September 24.

One, 78 mm., from Taiohae, Nukuhiva, Marquesas Islands, September 26, in the academy.

NASO EOUME (Lesson)

One example, head 100 mm. long, purchased at Hanamui, Ua Huka, Marquesas Islands, September 25.

Family POMACENTRIDAE

ABUDEFDUF SAXATILIS (Linnaeus)

One, 50 mm., from Ua Huka, Marquesas Islands, September 24.

ABUDEFDUF SORDIDUS (Forskål)

Three, 62 to 84 mm., Marquesas Islands, September.

Four, 50 to 76 mm., from Ua Huka, Marquesas Group, September 24.

Two examples, 21 or 22 mm., from Eiao, Marquesas Group, September 28.

Five, in the academy, from tide pools at Taiohae, Nukuhiva, Marquesas Group, September 26. Length, 55 to 85 mm.

ABUDEFDUF UNIOCELLATUS (Quoy and Gaimard)

One, 28 mm., from Ua Huka, Marquesas Group, September 24.

One, in the academy, 21 mm. long, from Hivaoa, Marquesas Island, September 12.

POMACENTRUS LEUCORUS Gilbert

Eight examples, 18 or 19 mm. long, from Black Beach Anchorage, Charles Island, Galapagos.

POMACENTRUS NIGRICANS (Lacépède)

Seventeen, 106 to 125 mm., from Ua Huka, Marquesas Islands, in tide pool, September 24.

One, in the academy, 115 mm. long, from Taiohae, Marquesas Group, September 26.

POMACENTRUS ARCTIFRONS Snodgrass and Heller

Three, in the academy, 155 to 160 mm., from tide pool at Tower Island, Galapagos Group, June 15. In alcohol blackish, paler below. Caudal, caudal peduncle, soft dorsal, and anal posteriorly more or less olivaceous, latter fins each with neutral or blackish submarginal band. Lips pale. Iris neutral gray.

Family LABRIDAE

EPIBULUS INSIDIATOR (Pallas)

Lower left mandibular ramus, length 145 mm. to end of lower branch, from Fakarava, Tuamotu Group, October 2.

THALASSOMA UMBROSTYGMA (Rüppell)

One, 47 mm. long, Ua Huka, Marquesas Group, September 24.

Family SCORPAENIDAE

SCORPAENA HISTRIO Jenyns

One, 21 mm., from Black Beach Anchorage, Charles Island, Galapagos Islands, June 27.

Family ELEOTRIDAE

ELEOTRIS FUSCA (Schneider)

One, 150 mm., Hivaoa, Marquesas Group, September 12.

Four, 62 to 95 mm., from tidal stream, Fatuhiva, Marquesas Group, September 14.

ELEOTRIS TUBULARIS Snodgrass and Heller

One, 78 mm., from Cocos Island. Very similar to *Eleotris fusca*, perhaps not distinct.

Family GOBIIDAE

COTYLOPUS COCOENSIS Heller and Snodgrass

One from Cocos Island. D. VI, I, 10. A. I, 10. Teeth greatly damaged, apparently weakly and imperfectly tridentate, at least in a smaller example, where they appear swollen somewhat at the juncture of each lateral spur forming the tridentation, though ends of most apparently worn down.

GOBIUS ORNATUS Rüppell

Three examples, 18 to 61 mm., from tide pool at Eiao, Marquesas Group, September 28.

Family ECHENEIDAE

ECHENEIS REMORA (Linnaeus)

One, 148 mm. long, from large *Manta birostris*, taken at Tower Island, Galapagos Group, June 16.

One, 116 mm., from off *Eulamia galapagensis*, taken at Cocos Island, June 10. Both this and preceding show 17 lamellae in the cephalic disk.

ECHENEIS ALBESCENS Schlegel

One, 250 mm., from the stomach of a large *Manta birostris* taken in Shavay Bay, Ua Huka, Marquesas Group, September 20.

One, 358 mm., from the stomach of *Manta birostris*, alive and had been seen in gills, Ua Huka, September 20.

One, 230 mm., from Tower Island, Galapagos Group, June 16. Though two were originally taken from a large *Manta birostris* only this one was preserved.

One, 111 mm., from *Manta birostris* at Shavay Bay, Ua Huka, September 20.

One, in the academy, 270 mm. long, from the mouth of *Manta birostris* but slipped into the stomach, Shavay Bay, September 21. All the specimens show 13 lamellae in the cephalic disk.

Family BLENNIIDAE

RUNULA AZALEA Jordan and Bollman

Two, 46 to 48 mm., from Black Beach Anchorage, Charles Island, Galapagos Group, June 27.

Two, in the academy, 46 to 49 mm., at surface of Garden Bay, Hood Island, Galapagos Group, June 30.

Runula albolinea Nichols² is supposed to differ in coloration. The terminal dark band on the dorsal fin is said to be entire, not broken as blackish blotches. It was based on specimens 35 to 46 mm. in length.

OPHIOBLENNIUS PINCHOTI, new species

FIGURE 3

Description.—Depth 4 to $4\frac{1}{4}$; head $3\frac{1}{3}$ to $3\frac{3}{5}$, width 2 to $2\frac{1}{4}$. Snout $3\frac{1}{3}$ to $4\frac{2}{5}$ in head; eye 3 to $3\frac{1}{3}$, greater than snout or interorbital, subequal with snout with age; maxillary reaches $\frac{1}{3}$ to $\frac{2}{5}$ in eye, length 2 to $2\frac{4}{5}$ in head; 4 canines in front of each jaw, each greatly bent, curved or crooked and each outer lower one flaring outward; interorbital $3\frac{1}{5}$ to $3\frac{1}{2}$ in head, broadly convex. Gill opening forms broad free fold over isthmus.

Body scaleless. Lateral line incomplete, superior, only extends far as depressed pectoral.

D. XII, 22 or 23, notch dividing fins only about half their depth, fin height about half of head; A. II, 21 to 23, front rays little highest, about high as dorsal rays; caudal long as head, emarginate behind; least depth of caudal peduncle $3\frac{1}{3}$; pectoral but little shorter than head, rays 15; ventral $1\frac{1}{2}$ in head.

Uniform light straw brown. Top of head with dusky blotch, also dusky on upper lip. Iris gray, apparently silvery in life. Along base of each dorsal and anal spine or ray small blackish spot. Caudal with vertical blackish bar. Fins otherwise pale or transparent, with pale yellowish tinge basally to vertical fins.

Type.—U.S.N.M. No. 91819, collected at Black Beach Anchorage, Charles Island, Galapagos, June 27, 1929, by Dr. A. K. Fisher. Also 49 paratypes, same data. Length, 21 to 53 mm.

² Zoologica, vol. 5, no. 4, p. 64, fig. 11, 1924. Indefatigable Island, Galapagos.

Diagnosis.—Differs from *Ophioblennius steindachneri* Jordan and Evermann, from the west coast of Mexico, in the coloration. The mainland species has dark longitudinal stripes on the caudal fin and a round, intense dark ocellated spot behind the eye. The coloration of *Ophioblennius pinchoti* is, however, unique, in that there is a large blackish blotch on the cranium and a black transverse basal band on the caudal.

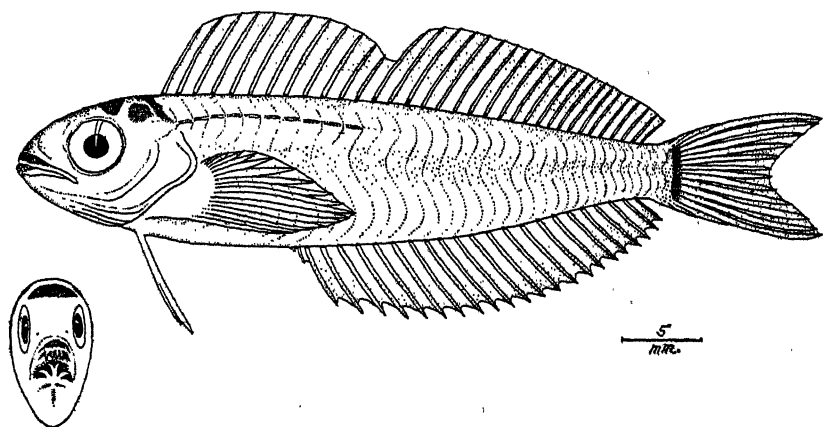


FIGURE 3.—*Ophioblennius pinchoti*, new species. U.S.N.M. No. 91819

GIFFORDELLA, new genus

Type species.—*Giffordella corneliae*, new species.

Diagnosis.—Differs from *Ophioblennius* in its entirely different physiognomy, also the lower teeth all flaring outward. Caudal truncate to slightly emarginate.

Named in slight appreciation to the Hon. Gifford Pinchot, governor of Pennsylvania, for his successful expedition to the South Seas.

GIFFORDELLA CORNELIAE, new species

FIGURE 4

Depth 4 to $4\frac{1}{8}$; head $3\frac{3}{4}$ to 4; width $1\frac{1}{4}$ to $1\frac{1}{8}$. Snout 3 to $3\frac{1}{2}$ in head; eye $2\frac{1}{3}$ to 3 in head, greater than snout to subequal with interorbital; maxillary reaches back $\frac{1}{5}$ to $\frac{1}{4}$ in eye length, $2\frac{4}{5}$ to $2\frac{7}{8}$ in head; teeth rather large, simple, conic, curved, uniserial in jaws and lower as 10 flaring outward each side; interorbital 3 to $3\frac{1}{5}$ in head, well convex. Gill opening large, extends forward about opposite hind eye edge, isthmus width about half eye.

Body scaleless. No flaps or tentacles. Lateral line not evident, side medianly with axial longitudinal impression.

D. 14, 14, fin height about two-thirds of head and divided by deep median notch, a little behind vertical of anal original; A. 14, each membrane notched terminally, fin height about one-half of head;

caudal slightly less than head, hind edge slightly emarginate; least depth of caudal peduncle 2 to $2\frac{2}{3}$ in head; pectoral slightly longer than head, lower median rays longest, reaches little beyond anal origin; ventral nearly long as head, of 2 simple rays.

Largely transparent brownish or colorless. Dark pigment spots on cranium. Iris silver gray to white.

Type.—U.S.N.M. No. 91821, collected near light, Nukuhiva, Marquesas Islands, September 25, 1929. Also 11 paratypes, same data, 16 to 22 mm.

Named for Mrs. Cornelia Bryce Pinchot, first lady of Pennsylvania.

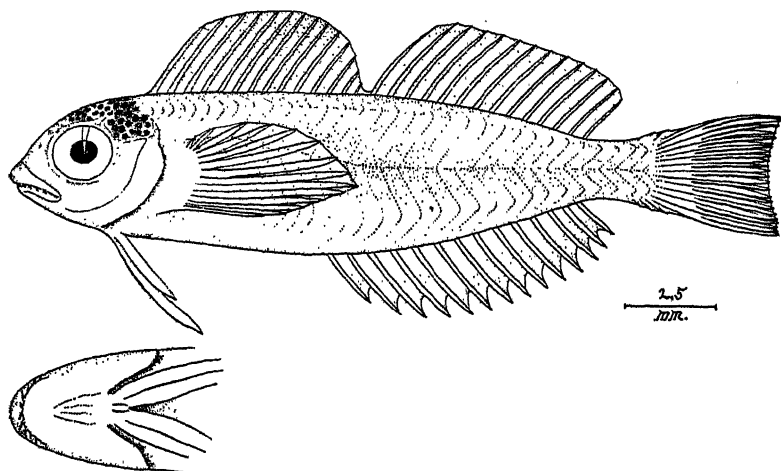


FIGURE 4.—*Giffordella cornelliae*, new species. U.S.N.M. No. 91821

SALARIAS EDENTULUS (Snyder)

Three, 27 to 99 mm., Eiao, Marquesas Group, September 28.

Four, 45 to 122 mm., Ua Huka, Marquesas Group, September 24.

Two in the academy, 59 to 75 mm., Taiohae, Nukuhiva, Marquesas Group, September 26. Uniform, blackish.

SALARIAS MELEAGRIS Valenciennes

Four, 68 to 81 mm., Eiao, Marquesas Group, September 28.
D. XIII, 21; A. 22. Upper lip with edge scarcely crenulate.

Family GOBIESOCIDAE

GOBIESOX POECILOPHthalmos Jenyns

Two in the academy, 87 to 106 mm. long, from Chatham Bay, Cocos Island. Found on stones in a stream. D. 7 or 8; A. 6.

One in the National Museum, 109 mm., from Cocos Island, June 6.

This species was based on a young example but 47 mm. long; from which most all the color had evidently faded. It is described as

"of a uniform very pale brown, or brownish white, without any markings whatever. The eyes were probably very brilliant in the living fish, the irides still showing traces of what seems to have been blue and golden pink." The fin rays are given as D. 7; A. 7.

Family MONACANTHIDAE

MONACANTHUS HISPIDUS (Linnaeus)

Two, 15 to 30 mm., from Key West, Fla., April 10.

Family OSTRACIONTIDAE

OSTRACION SEBAE Bleeker

One, 164 mm., from Maragneii, Toau Atoll, Tuamotu Group, October 5. Scattered white spots over top and sides of carapace, under surface uniform.

Family TETRODONTIDAE

SPHOEROIDES ANNULATUS (Jenyns)

One, 140 mm., from Conway Bay, Indefatigable Island, Galapagos Group, June 24.

Family ANTENNARIIDAE

HISTRIO HISTRIO (Linnaeus)

One, 44 mm., Key West, Fla., April 10.

A SECOND COLLECTION OF BIRDS FROM THE PROVINCES OF YUNNAN AND SZECHWAN, CHINA, MADE FOR THE NATIONAL GEOGRAPHIC SOCIETY BY DR. JOSEPH F. ROCK

By J. H. RILEY

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United States National Museum.*

INTRODUCTION

After Dr. Joseph F. Rock had rested sufficiently from his explorations in Kansu and Tibet for the Arnold Arboretum,¹ he returned to China to make explorations in the interests of the National Geographic Society. Assembling his outfit and Nashi collectors, he proceeded to Yungning in Yunnan and collected in the vicinity or on near-by mountains early in May, 1928, and then moved north into the semi-independent kingdom of Muli (or Mili) the same month. Doctor Rock had previously visited Muli in 1924,² but this was only a hurried visit and not many birds were collected. Muli is in southwestern Szechwan to the northward of Yungning, Yunnan. The lamasery of Muli is located on the Litang River, but the kingdom is of indefinite extent, and part of it is ruled by native bandits. The country is very mountainous and the mountains very high. To the northwest of Muli lies the unknown snow range of Konka Rison-quemba, which rises to a height of 25,000 feet and on which birds were collected at altitudes of 14,000 to 17,000 feet. Doctor Rock had to obtain permission, through the Muli king, from the local bandit that controlled the region, to visit this mountain, to which he made two trips, one in June and another in August. He started to make a third, but the bandit sent him word not to come again at the peril of his life. The remainder of the collection in Muli territory that year was made to the east or northeast of the Muli lamasery, in the Yalung Valley, the Muti Konka Mountains, or on the journey into the country, and the return into Yunnan for the

¹ Bull. Mus. Comp. Zool., vol. 68, pp. 313-381, pls. 1-5, 1928.

² Cf. Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 2, 1926.

winter. No one had ever collected birds in this region before, but the avifauna is much the same as that of northwestern Yunnan, with the exception of a few species that have not been recorded from that Province to date. Doctor Rock returned to Yunnan to spend the winter and to prepare for a journey still farther north in the spring through an unexplored region of Szechwan. While wintering in Yunnan at Ngulukö, on the east slopes of the Likiang Mountains, he had his men collect in the vicinity.

With the return of spring, early in April, 1929, Doctor Rock and his party moved northward into Muli territory again on his way to explore the Minya Konka snow range to the northeast of the Yalung River and south of Tatsienlu. On this journey he went as far as Tatsienlu, which was reached some time in May. After a couple of weeks' rest there, he returned to the Yulonghsi Valley, south of Tatsienlu, and went eastward to explore the Minya Konka Range, the highest peak of which reaches a height of 25,600 feet, with several others almost as high. To the westward of the Minya Konka Range there is another high parallel chain some 20,000 feet in height, and it is this ridge that is visible from the mountains to the westward of Tatsienlu and not the Minya Konka.³

The party then started the return journey by a route to the westward of the one pursued on the northward march, crossing the Yalung at Baurong in July, and were back in Yunnan by August.

When the expedition reached Yungning on the return journey, Doctor Rock found all the ferries across the Yangtze River destroyed by rebels, and the party was marooned for two months on an island in Yungning Lake, but he managed to send some of his men to collect in the northwest corner of Yunnan in August, where they started operations in the Luddü Mountains west of the Yangtze; they then moved northward to the Fuchuanshan, between the Mekong and the Salween, in September; to Weihsi, between the Mekong and Yangtze, the same month; and during October collected at two stations on Ndamucho, on the divide between the Yangtze and Mekong, south of Lütien, at 11,000 and 14,000 feet. Being threatened by Konkaling bandits from the northwest and rebel forces from the south, the party at Yungning Lake found themselves in a precarious position. Doctor Rock appealed to a friendly Mongol chief for aid, and the chief sent a number of his best swimmers with a lot of goatskins. These were inflated to form rafts, and the party managed to cross under great difficulties without losing any of its valuable collections and to reach its base again at Ngulukö, on the east slopes of the Likiang Mountains. Doctor Rock's men collected some birds here

³ See Nat. Geog. Mag., vol. 53, pp. 385-437, 1930, many illustrations and a small map of the route; and vol. 60, pp. 1-65, 1931.

in November, 1929, and some in January, 1930. This was the last collecting done, and Doctor Rock was soon able to leave the country for the United States.

On the whole journey the expedition collected something more than 1,700 birds, in addition to a very large number of botanical specimens. These have been generously presented to the United States National Museum by the National Geographic Society. Quite a number of the forms involved were not before represented in the National Museum collection. The study of this collection has enabled me to describe the following five birds:

Columba rupestris australis;

Garrulus albogularis eous;

Dryonastes berthemyi ricinus;

Fulvetta insperata;

Spelaornis rocki.

A number of other specimens represent extensions of ranges of previously known forms. The collection as at present worked out consists of 254 forms. Doctor Rock was the first Caucasian to explore much of the country under consideration. Nevertheless, while his explorations were still in progress, the well-known collector Henry Stevens passed through Muli on his way to Tatsienlu and traversed part of the country previously covered by Doctor Rock. He has published a short sketch of his route.⁴

Doctor Rock is preparing an account of his travels for the National Geographic Society and a map of the country, but as he has returned to China to do the work neither is available to me in preparing this report. The only data at hand are the list of localities and the specimens and the article on the Minya Konka previously mentioned.

LOCALITIES WHERE BIRDS WERE COLLECTED

The list of localities is given below as it may prove useful in the future. The altitudes are only the heights at which birds were collected and may or may not be the summit of a ridge or mountain. They are arranged alphabetically for ready reference.

Aloching: 12,500–13,500 feet, north of Kulu, Szechwan, April, 1929.

Barongomba (or Petien): One day northeast of Baurong in Ngunze Kong Valley, east of the Yalung, 11,000–12,000 feet, Szechwan. No date. [1929.]

Baude-Shaya: Northeast of Muli, Szechwan, July, 1928.

Baurong: 7,600 feet, on the Yalung, Szechwan, July, 1929.

Bonti or vicinity: East of Waerhdje, 12,000–14,500 feet, Muli, Szechwan, July, 1928.

Brülo-kong Valley: North of Druduron Pass in Chiu-lung-hsien territory, east of the Yalung, 13,000–15,900 feet, May, 1929. Chiu-lung-hsien is an 8 days' trip southwest of Tatsienlu, Szechwan.

⁴ Bull. Brit. Orn. Club, vol. 50, pp. 46–54, 1930.

- Chengtze: North of the Chiprinla and south of Mudju and Yulonghsi, 14,500–15,900 feet, Szechwan, May, 1929. Chengtze is 5 days' trip south of Tatsienlu.
- Chide: 14,500 feet, east of Muli, Szechwan, July, 1928.
- Chinhaitze: 11,000–11,300 feet, northwest Yunnan, May, 1928.
- Chiprinla: 16,500 feet, north of Chiu-lung-hsien and Chüchulongba, Szechwan, July, 1929.
- Chiu-lung-hsien territory: East of the Yalung, 8 days' trip southwest of Tatsienlu (halfway between Muli and Tatsienlu), May, 1929.
- Chüchulongba: A valley north of the hamlet of Tanku in Chiu-lung-hsien territory, 13,000–14,000 feet, Szechwan. No date. [1929.]
- Chütien: On the west bank of the Yangtze north of Shiku, 6,500 feet, northwest Yunnan, October, 1929.
- Djago: Between Muli and Kulu lamaseres, 10,000–12,000 feet, Szechwan, April, 1929.
- Djishi: Northeast of Muli, Yalung, 11,000–13,000 feet, July, 1928.
- Djishigotong: 12,500–13,000 feet, Muli, July, 1928.
- Djobi: 12,000 feet, Muli, Szechwan, July, 1928.
- Dshizhi: North of Aloching and Kulu, but west of the Yalung, 11,000–13,500 feet, April, 1929.
- Dzampe: Grassland in Muli territory, west of the Yalung River, 14,000 feet, July, 1929.
- Fuchuanshan: Mekong-Salween divide, 9,800–12,000 feet, Yunnan, September, 1929.
- Fungkou: 6,500–9,000 feet, Yunnan, May, 1928.
- Gauwua (or Gawua): South of Yowabu Pass in Yungning territory, 11,000–11,500 feet, Yunnan, April, 1929.
- Gibboh, Mount: 12,500–14,000 feet, south of Muli lamasery, August, 1928; April, 1929. Mount Gibboh is a huge limestone range over which a pass leads from Yunnan into Muli territory, Szechwan.
- Gou-khü-ko: 13,000 feet, Yangtze loop, Yunnan, April, 1929.
- Gowa (forests of): 10,000 feet, south of Yulo, Yunnan, May, 1928.
- Jesila: 15,600–16,300 feet, pass across the Minya Konka snow range, 3 days' trip south of Tatsienlu, May, 1929.
- Jesilongba Valley: 14,300–16,000 feet, north of Yulonghsi and the Jesila, 2 days' trip south of Tatsienlu and near the Minya snow range, Szechwan, May, 1929.
- Kere: South of Kulu, 9,000 feet, Muli, December, 1928.
- Konka, Mount: Muli, 14,000–17,000 feet, June and August, 1928.
- Konkalongba: 14,500 feet, Minya snow range, east of Yulonghsi, Szechwan. No date. [1929.]
- Kopati (forests of): Muli, June, 1928.
- Kulu Mountains: East of Muli, 11,000–13,000 feet, December, 1928, and April, 1929.
- Laitsolo (gorges of): 10,000 feet, northwest Yunnan, November, 1928.
- Lapo-laze: 9,000–10,000 feet, Yunnan, May, 1928.
- Lauch: Upper slopes of Fuchuanshan, 10,000–12,000 feet, Yunnan, September, 1929.
- Lautsolö Gorge: West of the Yangtze River, in Likiang territory, 9,000 feet, Yunnan, April, 1929.
- Likiang Mountains: 9,400–15,000 feet, Yunnan, September–October, 1928; January–February, 1929; and January, 1930.
- Luddü Mountains: West of the Yangtze and Chungtien Rivers, 12,000–13,000 feet, northwest Yunnan, August, 1929.

- Lütien: West of the Yangtze and east of the Mekong, 10,000 feet, northwest Yunnan, September, 1929.
- Mbayiwua: North of Likiang in the Yangtze loop, 10,000 feet, Yunnan, April, 1929.
- Mitzuga, Mount: 10,000–15,600 feet, Muli, June, 1928.
- Mudju: Between Chengtze and Yulonghsi, 11,000 feet, Szechwan, June, 1929. Beyond Mudju are grasslands until one has crossed the Jesila over the Minya Range to the central part of Jesilongba, where the tree growth again occurs.
- Muli Mountains: 9,000–10,000 feet, May–June, 1928; April, 1929.
- Muli Valley: 9,500–10,000 feet, May and June, 1928.
- Mundon: East of the Yalung, overlooking the Yalung Gorge, 13,000 feet, border of Muli and Chiu-lung-hsien territory, Szechwan, May, 1929.
- Mutirong: In the Yalung Gorge, Muli, 7,000–7,800 feet, April, 1929.
- Ndamucho: South of Lütien and west of the Yangtze River on the Mekong–Yangtze divide, 11,000 and 14,000 feet, Yunnan, October, 1929.
- Ngulukö: Eastern slopes of the Likiang Mountains, 9,600 feet, Yunnan, November, 1929.
- Noön: Valley east of Muli, 10,500–11,000 feet, August, 1928.
- Peshui River: Eastern slopes of Likiang Mountains, 11,000 feet, Yunnan, March, 1929.
- Petien: See Barongomba.
- Baronki: Northeast of Muli, 12,400–14,200 feet, August, 1928.
- Ronapien region: Shouchu Basin, Muli, 14,500 feet, August, 1928.
- Shangentze: South foot of the Druduron Pass, Tatsienlu territory, 14,500 feet, Szechwan, May, 1929.
- Shaya: Northeast of Muli, July, 1928.
- Shelän Forests: Between Muli and Kulu lamaseries, Muli, 13,400 feet, April, 1929.
- Shenlä Valley: 12,000 feet, Kulu-Djago, Muli, December, 1928.
- Shintsang: West of Weihsi and east of the Mekong, 11,000 feet, Yunnan, September, 1929.
- Shouchu Valley: 11,300–12,000 feet, Muli, August, 1928.
- Tatsienlu: 9,500–10,000 feet, Szechwan, May, 1929.
- Tokesher Forest: 10,000 feet, Yunnan, May, 1928.
- Tsoso (between Tsoso and Kulu): 10,500 feet, Muli, December, 1928. I do not know whether this is north or south of Kulu, but it is not far from the latter.
- Tyon-kong Forests: 12,000 feet, Muli, July, 1928.
- Vudju Mountains: 10,000 feet, south of Muli, May, 1928, and April, 1929.
- Waerhdje, or vicinity: 14,000–15,000 feet, Muli, July and August, 1928.
- Watogomba: 12,500–14,000 feet, Yalung watershed, Muli, July, 1928.
- Weihsi: West of the Yangtze River, 8,000–9,000 feet, northwest Yunnan, September, 1929.
- Wenronkong: East of Dzanpiran Pass in Muli territory, east of the Yalung, 14,500 feet, April–May, 1929.
- Yalung River Gorge: 11,000–12,500 feet, Muli, July, 1928.
- Yankongran Pass: North of Kulu, Muli, 15,500 feet, July, 1929.
- Yanwekong Valley: East of the Yalung and north of Wanzanron, a pass that forms the Muli and Chiu-lung-hsien border, 10,000–12,000 feet, May, 1929.
- Yetsi Valley: North of Kulu (one day), 12,000 feet, Muli, April, 1929.
- Yuli Forest: 13,000 feet, Yunnan, May, 1928.

Yulinggong: 11,000 feet, in the Jesilongba Valley, 10 miles south of Tatsienlu, May, 1929. This evidently is the same locality visited by the Rev. David C. Graham in 1923, who spelled the name "Ü Long Kong."⁵

Yulo: West of the Likiang Mountains, 7,000 feet, Yunnan, August, 1929.

Yulonghsi Valley: Tatsienlu territory, 13,000-16,000 feet, May, 1929. Grasslands resembling very much the grasslands of eastern Tibet and extreme western Kansu. Yulonghsi is separated from the Minya Konka snow range by a high, grassy, rock-crowned spur but lies parallel to the snow range. It is 3 or 4 days' trip south of Tatsienlu and south of Jesila, the pass across the northern end of the Minya Range.

Yungning: City and prefecture, in northwest Yunnan near the Szechwan border. Doctor Rock's men collected on the plain, in the mountains, and on the lake, at 9,000 to 13,000 feet, May, November, and December, 1928, and January, 1929.

Zimi Valley: West of Waerhdje, Muli, 14,000-15,000 feet, August, 1928.

Family COLYMBIDAE, Grebes

1. PROCTOPUS NIGRICOLLIS NIGRICOLLIS (Brehm)

Podiceps nigricollis BREHM, Handbuch der Naturgeschichte aller Vögel Deutschlands, p. 963, 1831 (Germany).

One male, Yungning Lake, 9,000 feet, Yunnan, December.

2. POLIOCEPHALUS RUFICOLLIS POGGEI (Reichenow)

Podiceps nigricans poggei REICHENOW, Journ. f. Orn., 1902, p. 125 (Tschili, China).

Two males, Yungning Lake, 9,300-13,000 feet, Yunnan, May and November-December.

The specimen taken in winter is considerably larger than the one taken in May, especially the bill.

Family PHALACROCORACIDAE, Cormorants

3. PHALACROCORAX CARBO SINENSIS (Shaw and Nodder)

Pelecanus sinensis SHAW and NODDER, The naturalist's miscellany, vol. 13, pl. 529, text, 1801 (China).

One female, Yungning Lake, 9,500 feet, Yunnan, December.

Family ARDEIDAE, Herons

4. ARDEOLA BACCHUS (Bonaparte)

Buphus bacchus BONAPARTE, Conspectus generum avium, vol. 2, p. 127, 1855 (Malay Peninsula).

One immature female, northwest Yunnan (Weihsi, 8,000-9,000 feet, September); one adult male and one adult female, southwest Szechwan (Mutirong, 7,000-7,800 feet, Muli, April; Yanwekong, 10,700 feet, May).

⁵ See Auk, vol. 42, p. 423, 1925.

5. *BUBULCUS IBIS COROMANDUS* (Boddaert)

Canoroma coromanda BODDAERT, Table des planches enluminées d'histoire naturelle de M. d'Aubenton, p. 54, 1783 (Coromandel).

One female, Tatsienlu, 9,500–10,000 feet, Szechwan, May.

Family CICONIIDAE, Storks

6. *CICONIA NIGRA* (Linnaeus)

Ardea nigra LINNAEUS, Systema naturae, ed. 10, p. 142, 1758 (North Europe).

One female immature, Yungning Plain, 9,500 feet, Yunnan, November–December.

Family ANATIDAE, Ducks, Geese, Swans

7. *MERGUS MERGANSER ORIENTALIS* Gould

Mergus orientalis GOULD, Proc. Zool. Soc. London, 1845, p. 1 (Amoy, China).

One female, Yungning Plain, 10,000 feet, Yunnan, November–December. The culmen measures 44.5 mm.

8. *CASARCA FERRUGINEA* (Pallas)

Anas ferruginea PALLAS, Vroeg's catalogue, Adumbratiuncula, p. 5, 1764, (Tartary).

One adult female, Chide, east of Muli, 14,500 feet, Szechwan, July.

9. *NYROCA FULIGULA* (Linnaeus)

Anas fuligula LINNAEUS, Systema naturae, ed. 10, p. 128, 1758 (Sweden).

One adult male, Yungning Lake, 9,500 feet, Yunnan, December.

10. *NYROCA NYROCA NYROCA* (Güldenstädt)

Anas nyroca GÜLDENSTÄDT, Novi Comm. Acad. Sci. Imp. Petropolitanae, vol. 14, pt. 1, p. 403, 1770 (South Russia).

Two males and one female, Yungning Lake, 9,300 feet, May; one female, Weihsi, 8,000–9,000 feet, September, Yunnan.

11. *DAFILA ACUTA ACUTA* (Linnaeus)

Anas acuta LINNAEUS, Systema naturae, ed. 10, p. 126, 1758 (Sweden).

One male, Weihsi, 8,000–9,000 feet, Yunnan, September.

This is just beginning to molt from the eclipse into the winter plumage.

12. *QUERQUEDULA QUERQUEDULA* (Linnaeus)

Anas querquedula LINNAEUS, Systema naturae, ed. 10, p. 126, 1758 (Sweden).

Two females, Weihsi, 8,000–9,000 feet, Yunnan, September.

13. *NETTION CRECCA CRECCA* (Linnaeus)

Anas orecca LINNAEUS, Systema naturae, ed. 10, p. 125, 1758 (Sweden).

Three males, Weihsi, 8,000–9,000 feet, Yunnan, September.

14. *ANAS PLATYRHYNCHA PLATYRHYNCHA* Linnaeus

Anas platyrhynchos LINNAEUS, Systema naturae, ed. 10, p. 125, 1758 (Sweden).

One adult female, Yungning Lake, 9,300 feet, Yunnan, May; one adult male and one adult female, Dshizhi, 12,000 feet, southwest Szechwan, April.

Family ACCIPITRIDAE, Hawks, Ospreys, etc.

15. *ACCIPITER NISUS NISOSIMILIS* (Tickell)

Falco nisosimilis TICKELL, Journ. Asiat. Soc. Bengal, vol. 2, p. 571, 1833 (Borabhum, Bengal).

One adult male (marked female), Likiang Mountains, Yunnan, October.

This specimen has the barring below much narrower than the typical European bird, and above it is somewhat darker. The wing measures 217 mm.

16. *ACCIPITER NISUS MELANOSCHISTUS* Hume

Accipiter melanoschistus HUME, Ibis, 1869, p. 350 (Kotegart, northwest India).

One subadult female, Likiang Mountains, Yunnan, September.

This specimen is not fully adult or at least has not acquired fully adult plumage. It is blackish brown above; below the bars are broad and blackish. Compared with the typical European race in the same stage of plumage, it is much darker above and the barring below is heavier. It evidently belongs to the resident breeding form. The wing measures 246 mm.

17. *MILVUS LINEATUS* (Gray)

Haliaeetus lineatus GRAY, Illustrations of Indian zoology chiefly selected from the collection of Major General Hardwicke, vol. 1, pl. 18, p. 1, 1832 (China).

One male, Likiang Mountains, 10,000 feet, January–February.

Family FALCONIDAE, Falcons

18. *CERCHNEIS TINNUNCULUS INTERSTINCTUS* (McClelland)

Falco interstinctus MCCLELLAND, Proc. Zool. Soc. London, 1839, p. 154 (Assam).

Two females, Likiang Mountains, October.

The two above specimens belong to the pale migrant race of this falcon.

19. *CERCHNEIS TINNUNCULUS SATURATUS* (Blyth)

Falco saturatus BLYTH, Journ. Asiat. Soc. Bengal, vol. 28, p. 277, 1859 (Tenas-serim).

Two females, Likiang Mountains, Yunnan, October; three females, southwest Szechwan (Dzeru, Shouchu Valley, 11,800 feet, August, and Mutirong, 7,000–7,800 feet, Muli, April).

This is the dark resident race of this falcon that I formerly called *Cerchneis tinnunculus interstinctus*,⁶ following earlier authors.

20. *FALCO REGULUS LYMANI* Bangs

Falco aesalon lymani BANGS, Bull. Mus. Comp. Zool., vol. 54, p. 465, 1912 (Tchegan-Burgazi Pass, Altai).

One female, Yungning Mountains, 12,000–13,000 feet, November–December.

This specimen agrees with a female from the original typical series, except the streaks below are a little broader.

Family TETRAONIDAE, Grouse

21. *TETRASTES SEWERZOWI SECUNDA* Riley

Tetrastes sewerzowi secunda Riley, Auk, vol. 42, p. 423, 1925 (near Tatsienlu, Szechwan).

One adult female and three young, Ronapien region, Shouchu Basin, 14,500 feet, August.

The young are just changing from the down into the first postnatal plumage and are probably not more than 2 weeks old at the most. Though the collector assigns all three of the above young to the adult, in my opinion he is in grievous error. One of the young belongs to the adult; the other two have a different color pattern, the tails about an inch long are brick red with a subterminal black spot and buffy tip; the tarsi are unfeathered. I would suggest they belong to *Perdix hodgsoniae sifanica*.

Family PHASIANIDAE, Pheasants

22. *PERDIX HODGSONIAE SIFANICA* Przewalski

Perdix sifanica PRZEWALSKI, Mongol i strana Tangut, vol. 2, p. 124, 1876 (mountains of Kansu); Rowley's Ornithological miscellany, vol. 2, p. 423, 1877.

Two males and six females, southwest Szechwan (Mount Konka, 15,700 feet, August; Yulonghsi Valley, 13,000–16,000 feet, May; Jesilongba Valley, 14,300 feet, June).

The undoubted males, taken in the breeding season, have a bare space below the eye and extending back of the eye over the ear cov-

⁶ Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 11, 1926.

erts; below the eye, separated from the subocular bare space by a narrow line of feathers, there is another bare space, and this second bare space contains some small wartlike structures, still red in the skin, and evidently in life capable of being inflated. According to the sexing of the collectors, both sexes have this inflatable skin, but the sexing of Rock's men is very unreliable and not to be trusted. I have no good seasonable material for comparison.

23. *ITHAGINIS CRUENTUS GEOFFROYI* Verreaux

Ithaginis geoffroyi VERREAUX, Bull. Soc. d'Acclim., ser. 2, vol. 4, p. 706, 1867 (Mupin).

Fourteen males and twelve females, southwest Szechwan (Mount Mitzuga, 12,500–14,500 feet, June; Bonti, east of Waerhdje, 14,500 feet, July; forests of Raronki, 12,500 feet, Shouchu Basin, August; Aloching, 12,500–13,500 feet, April; Dshizhi, 13,500 feet, April; Wenronkong, 14,500 feet, Muli, April–May; Mundon, 13,000 feet, May; Shangentze, 14,500 feet, May; Jesilongba, 14,500–16,000 feet, May; Chengtze, 14,500–15,900 feet, south of Tatsienlu, May).

The present form and *Ithaginis c. clarkei* are very much alike; the only constant difference in a series of both forms appears to be the blackish or dark mouse-gray chin of *geoffroyi*, this part in *clarkei* being buffy tinged with a reddish wash. There are a number of average characters separating the two forms, however. The females appear to be indistinguishable. The ranges of the two forms are very close to each other in this region, apparently only separated by the valley of the Yangtze.

Along with the rough skeletons sent in by the Rev. David C. Graham from the Yulonghsi Gorge (written Ülongsi by Graham) there are two immature males, about half grown, taken August 9. They have already begun to assume the red under tail coverts and green of the adult plumage, while the tarsi are still small and delicate and the bills small and red. This seems to indicate that the adult plumage of the male is assumed some time before adult growth is reached and explains the difference in size between *Ithaginis wilsoni* Thayer and Bangs and *geoffroyi*, and the reason the two were both found on Washan.

24. *ITHAGINIS CRUENTUS CLARKEI* Rothschild

Ithaginis clarkei ROTHSCHILD, Bull. Brit. Orn. Club, vol. 40, p. 67, 1920 (Likiang Mountains, Yunnan).

One male, Likiang Mountains, 12,500 feet, Yunnan, January.

25. *LERWA LERWA MAJOR* Meinertzhagen

Lerwa lerwa major MEINERTZHAGEN, Bull. Brit. Orn. Club, vol. 47, p. 101, 1927 (Tatsienlu, Szechwan).

One male, Likiang Mountains, 15,000 feet, Yunnan, January.

I have no typical Szechwan birds for comparison, and only two old specimens of *Lerwa lerwa lerwa* from the "Himalayas." From the latter the Yunnan specimen differs as follows: Above, the light crossbars are lighter and on the head white rather than buffy; the primaries are black rather than brownish black; the chestnut of the lower parts is somewhat deeper; the bill is larger.

This seems to be a new record for Yunnan.

26. PUCRASIA MEYERI Madarász

Pucrasia meyeri MADARÁSZ, Ibis, 1886, p. 145 (central Tibet).

One male and one female, Likiang Mountains, 15,000 feet, January.

These are the first specimens of this fine species received by the United States National Museum.

27. TETRAOPHISIS SZECHENYII Madarász

Tetraophasis szechenyii MADARÁSZ, Zeitschr. ges. Orn., vol. 2, p. 50, pl. 2, 1885 (East Tibet).

Two males and one female, northwest Yunnan (Likiang Mountains, 14,000 feet, January); five males and five females, southwest Szechwan (Mount Mitzuga, 13,000–14,500 feet, Muli, June; forests of Bonti, east of Waerhdje, 14,000 feet, July; Kulu Mountains, 12,000–13,000 feet, April; Aloching, 12,500–13,500 feet, north of Kulu, April; Minya Mountains, Konkalongba, 14,500 feet, no date).

28. TETRAOGALLUS TIBETANUS HENRICI Oustalet

Tetraogallus henrici OUSTALET, Ann. Sci. Nat., ser. 7, vol. 12, p. 296, 1891 (Tatsienlu, Szechwan).

Two males, two females, and two downy young, Mount Konka, 15,700–17,000 feet, southwest Szechwan, June and August.

I have only a male of *T. t. tibetanus* with which to compare the present race, and it differs considerably from that form. In the first place *henrici* has a broad band of slaty gray across the chest separating the white throat from that of the chest, lacking in *tibetanus*; *henrici* is darker above; the upper tail coverts much lighter, without the rufous tone; and there are other differences.

The females differ from the males in having the sides of neck with black and buffy markings, the chest with some black markings also, and the chest band with fine black and buffy stippling on a gray background. The males have a little stippling on the chest band, but not to the same extent as in the females. The males (in the skin) have a yellow bill and cere, while in the female the cere and beak are dark grayish olive, becoming horn color at the tip.

One young is in the downy stage, except for the wings and tail; it was taken in June. The other young was taken in August and is in a more advanced stage of plumage; it still retains the down on the head and a little on the breast.

29. *CROSSOPTILON CROSSOPTILON* (Hodgson)

Phasianus crossoptilon HODGSON, Journ. Asiat. Soc. Bengal, vol. 7, p. 864, pl. 46, 1838 (Tibet).

Three males, northwest Yunnan (Likiang Mountains, October); six males, three females, and three unsexed, southwest Szechwan (forests of Tyon-kong, Watogomba, 14,000 feet, July; forests of Bonti, east of Waerhdje, 14,000 feet, July; Konkalongba, 14,500 feet, no date; Chengtze, 14,500—15,900 feet, May).

All the specimens from the Likiang Mountains (four) examined by me have the middle of the back pure white, while four specimens from near Tatsienlu, Szechwan, have the middle of the back washed with pale neutral gray. At Tyon-kong and Konkalongba both styles of coloration were taken, so the two styles can not be geographic. I agree with Grant[†] that *Crossoptilon drouynii* Verreaux is probably only a synonym of *C. crossoptilon*.

30. *CHRYSOLOPHUS AMHERSTIAE* (Leadbeater)

Phasianus amherstiae LEADBEATER, Trans. Linn. Soc. London, vol. 16, p. 129, pl. 15, 1828 (mountains of Cochin China).

One adult male, forests of Kopati, southwest Szechwan, June 1; three adult males, one immature male, and two adult females, northwest Yunnan (Likiang Mountains, 9,400–12,500 feet, January; Luddü Mountains, 12,000–13,000 feet, August; Ndamucho, 14,000 feet, October).

The immature male was taken in October. It has begun to assume the crown and nape plumage of the adult; the chin, center of the throat, and jugular patch are coming in; the breast and belly plumage, but not the chest, of the adult have been assumed; the new tail is coming in, only three outside feathers on each side of the previous plumage remain, even the center feathers are not more than one-third developed, however; the wings and remainder of the upper plumage show no sign of being replaced as yet.

31. *PHASIANUS COLCHICUS ELEGANS* Elliot

Phasianus elegans ELLIOT, Ann. Mag. Nat. Hist., ser. 4, vol. 6, p. 312, 1870 (Szechwan).

One adult male and one immature male, Likiang Mountains, 9,400–13,000 feet, January and August.

Family GRUIDAE, Cranes

32. *GRUS NIGRICOLLIS* Przewalski

Grus nigricollis PRZEWALSKI, Mongol i strana Tangut, vol. 2, p. 135, pl. 9, 1876 (Kokonor); Rowley's Ornithological miscellany, vol. 2, p. 436, pl. 9, 1877 (translation).

Two females, Yungning Plain, 9,500 feet, Yunnan, December and January.

[†] Catalogue of birds in the British Museum, vol. 22, p. 294, 1893.

Family CHARADRIIDAE, Plovers, etc.

33. VANELLUS VANELLUS (Linnaeus)

Tringa vanellus LINNAEUS, Systema naturae, ed. 10, p. 148, 1758 (Sweden).

One female, Weihsi, 8,000–9,000 feet, Yunnan, September.

34. PLUVIALIS DOMINICUS FULVUS (Gmelin)

Charadrius fulvus GMELIN, Systema naturae, vol. 1, pt. 2, p. 687, 1789 (Tahiti).

One female, Weihsi, 8,000–9,000, Yunnan, September.

35. CHARADRIUS DUBIUS DUBIUS Scopoli

Charadrius dubius SCOPOLI, Deliciae florae et faunae Insubricae, pt. 2, p. 93, 1786 (Luzon).

One male, Weihsi, 8,000–9,000 feet, Yunnan, September.

36. CHARADRIUS PLACIDUS Gray

Charadrius placidus GRAY, Catalogue of the specimens and drawings of mammals, birds, reptiles, and fishes of Nepal and Tibet, presented by B. H. Hodgson to the British Museum, ed. 2, p. 70, 1863 (Nepal).

One male and one female, Likiang Mountains, 10,000 feet, January–February; three males, two females, and one unsexed, Weihsi, 8,000–9,000 feet, Yunnan, September.

Family SCOLOPACIDAE, Snipe, etc.

37. PISOBIA TEMMINCKII (Leisler)

Tringa temminckii LEISLER, Nachträge zu Bechsteins Naturgeschichte Deutschlands, pp. 63–73, 1812 (near Hanau on the Main, Germany).

Three males, Weihsi, 8,000–9,000 feet, Yunnan, September.

38. ACTITIS HYPOLEUCOS (Linnaeus)

Tringa hypoleucos LINNAEUS, Systema naturae, ed. 10, p. 149, 1758 (Sweden).

One male and one female, Yulo, 7,000 feet, Yunnan, August.

39. TOTANUS TOTANUS EURHINUS Oberholser

Totanus totanus eurhinus OBERHOLSER, Proc. U. S. Nat. Mus., vol. 22, p. 207, 1900 (Lake Tsomoriri, Ladak).

One male, Jesilongba, 14,500–16,000 feet, Szechwan, May.

40. TRINGA OCHROPUS Linnaeus

Tringa ochropus LINNAEUS, Systema naturae, ed. 10, p. 149, 1758 (Sweden).

Two males and one female, Weihsi, 8,000–9,000 feet, Yunnan, September.

41. *RHYACOPHILUS GLAREOLA* (Linnaeus)

Tringa glareola LINNAEUS, Systema naturae, ed. 10, p. 149, 1758 (Sweden).

One female, Weihsi, 8,000–9,000 feet, Yunnan, September.

42. *CAPELLA SOLITARIA* (Hodgson)

Gallinago solitaria HODGSON, Gleanings in science, vol. 3, p. 238, 1831 (Nepal).

Three females, northwest Yunnan (Likiang Mountains, September and March; Lütien, 10,000 feet, September); one female, southwest Szechwan (Dshizhi, 12,000 feet, April).

The specimen from Dshizhi is a bird of the previous year, I suppose, as it is quite different from the adult. The sides of the neck are buffy; the chest feathers are tipped with white, and this region is more mottled than in the adult; the scapulars are broadly margined with buffy; the five outer primaries are margined with white; and there are other differences. The wing measures 160 mm.

43. *SCOLOPAX RUSTICOLA RUSTICOLA* Linnaeus

Scolopax rusticola LINNAEUS, Systema naturae, ed. 10, p. 146, 1758 (Sweden).

One male, Likiang Mountains, 10,000 feet, Yunnan, January.

Family LARIDAE, Gulls, etc.

44. *LARUS RIDIBUNDUS SIBIRICUS* Buturlin

Larus ridibundus sibiricus BUTURLIN, Messenger Orn., vol. 2, p. 66, 1911 (Kolyma Delta and Ussuriland).

One immature female, Yungning Plain, 9,500 feet, November–December; one adult female, Yungning Lake, 9,500 feet, December; and one adult male, Likiang Mountains, 9,600 feet, January, Yunnan.

45. *LARUS FUSCUS TAIMYRENSIS* Buturlin

Larus affinis taimyrensis BUTURLIN, Messenger Orn., vol. 2, p. 149, 1911 (Gulf of Yenisei, Siberia).

One immature male, Yungning Lake, 9,500 feet, Yunnan, January. This seems to be a new record for this Province.

Family COLUMBIDAE, Doves, etc.

46. *SPHENURUS SPHENURUS YUNNANENSIS* (LaTouche)

Sphenocercus sphenurus yunnanensis LATOUCHE, Bull. Brit. Orn. Club, vol. 42, p. 13, 1921 (Lutukow, southeast Yunnan).

One female, forests of Gowa, 10,000 feet, northwest Yunnan, May, and one female, Mount Mitzuga, 10,000 feet, Muli, southwest Szechwan, June.

47. *STREPTOPELIA CHINENSIS FORRESTI* Rothschild

Streptopelia chinensis forresti ROTHSCHILD, Nov. Zool., vol. 32, p. 293, 1925 (Tengyueh, Yunnan).

One male and one female, Likiang Mountains, 10,000 feet, Yunnan, January–February.

48. *OENOPELIA TRANQUEBARICA HUMILIS* (Temminck)

Columba humilis TEMMINCK, Nouveau recueil de planches coloriées d'oiseaux, liv. 44, pl. 259, 1824 (Bengal, Luzon).

Six males and one female, Tatsienlu, 9,500–10,000 feet, Szechwan, May.

The five adult males in the above series have been compared with seven adult males from Luzon. On the whole the Chinese series appears to be slightly darker, but there are individual birds that are so close that they can be distinguished only with difficulty. The Luzon birds have slightly shorter wings. The seven Luzon birds' wings measure: 130.5–140 mm. (136.9); while the five Chinese birds' wings measure: 139.5–142 mm. (140.7). On the whole the Luzon and Chinese series are too close to separate by name.

49. *COLUMBA HODGSONII* Vigors

Columba hodgsonii VIGORS, Proc. Zool. Soc. London, 1832, p. 16 (Nepal).

Two males, Muli Valley, 9,600 feet, southwest Szechwan, June.

50. *COLUMBA LEUCONOTA GRADARIA* Hartert

Columba leuconota gradaria HARTEET, Nov. Zool., p. 85, 1916 (Sungpan, Szechwan).

Three males and three females, southwest Szechwan (Mount Konka, 16,500 feet, June; Ronapien, Shouchu Basin, 14,500 feet, August; Brüolo-kong Valley, 13,000–15,900 feet, May; Chengtze, 14,500–15,900 feet, May).

Specimens from Yunnan and from the southern border of southwest Szechwan have the mantle somewhat darker than birds from farther north, but agree with northern birds in having lighter, grayer heads than the typical *leuconota* from Kashmir. On the whole the Yunnan specimens are better placed with the northern race, though somewhat intermediate.

51. *COLUMBA RUPESTRIS AUSTRINA* Riley

Columba rupestris austрина RILEY, Proc. Biol. Soc. Washington, vol. 43, p. 133, 1930 (Chengtze, Szechwan).

Three males, Chengtze, 14,500–15,900 feet, Szechwan, May.

Besides the above, the United States National Museum contains three males and three females from Szechwan (Tatsienlu or vicinity,

Nachuka, and Sungpan). From northeast Kansu and just over the border in Inner Mongolia it has four males and two females, and from the Eastern Tombs, Chihli, one female.

The series from Szechwan is darker on the breast and belly and considerably darker on the upper tail coverts when compared with the Kansu and more northern specimens; there seems to be no appreciable difference in size. The single male from Sungpan is somewhat intermediate; the upper tail coverts are slightly lighter than those of the more southern birds, but darker than in the northern race; I would, however, place it with the southern form for the present.

When the above race was described, I overlooked comparing it with *Columba taczanowskii* Stejneger.⁸ The latter was founded upon a single adult male from southern Korea. This specimen is certainly darker than the series from Inner Mongolia and northeastern Kansu, which I regard as *Columba rupestris rupestris* for the present, and the chest is more extensively suffused with a darker vinaceous-purple. *Columba taczanowskii* is certainly very close to *Columba rupestris australis*; it is only slightly lighter and has the chest a little more extensively vinaceous-purple. If more material should make it advisable to recognize an eastern race of *Columba rupestris*, it seems to me the name *Columba leucozonura* Swinhoe⁹ described from Talien Bay, southern Manchuria, will have to be used for it.

Family CUCULIDAE, Cuckoos

52. CUCULUS CANORUS BAKERI Hartert

Cuculus canorus bakeri HARTERT, Die Vögel der paläarktischen Fauna, vol. 2. Heft 7, p. 948, 1912 (Shillong, Assam).

One female, Yangtze Gorge, Yungning, 10,200 feet, Yunnan, May; three males and one female, southwest Szechwan (between Bonti and Waerhdje, 14,000 feet, July; Yulonghsi Valley, 13,000–16,000 feet, May; Tatsienlu, 9,500–10,000 feet, May).

If Stuart Baker's description¹⁰ of *Cuculus optatus* holds good, then the majority of the birds that were so identified previously from Yunnan¹¹ and the above belong to *bakeri*. All the specimens in the United States National Museum from the mountains of Yunnan and Szechwan, except three young of the year from Yunnan, have the carpo-metacarpal joint of the wing white, barred more or less with grayish or dusky. The only available specimens having the carpo-metacarpal joint white and unbarred are six from Japan (only two adults), one from Copper Island, two from near Shanghai, two

⁸ Proc. U. S. Nat. Mus., vol. 16, p. 624, 1893.

⁹ Ibid., 1861, p. 259.

¹⁰ Fauna of British India, Birds, vol. 4, ed. 2, p. 141, 1927.

¹¹ Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 15, 1926.

from Nanking, and three young of the year from Yunnan. All the latter are smaller than those with the barred carpo-metacarpal. Now the birds that have the carpo-metacarpal barred are darker above and the barring below is heavier than in *Cuculus canorus telephonus* and apparently represent the breeding form throughout the mountains of western China from northern Szechwan south into Yunnan and Assam. From the description, I believe this to be *Cuculus canorus bakeri* Hartert. This constitutes only an extension of the known range northward in the mountains.

Rothschild¹² records *bakeri* from Yunnan and Lönnerberg¹³ from western Kansu, and Bangs and Peters¹⁴ have recently not only recorded it from the mountains of Kansu but from eastern Tibet.

The wings of the four undoubted adults of *optatus* measure: 213, 213, 203, and 195 mm. Twelve males of the dark breeding birds from the mountains of Yunnan and Szechwan with barred carpo-metacarpal feathers have wings measuring 213–231 (225) mm. Three females of the same form from the region have wings measuring 213, 220, and 220 mm. Thus it will be seen that *Cuculus optatus* apparently breeds in the mountains along with the present form, as the three immatures from Yunnan indicate.

The four birds recorded by the author¹⁵ from Kansu as *Cuculus canorus telephonus* prove on reexamination to be both that form and *bakeri*. The adults from Ninghsia and Lanchow were correctly determined; the immature and adult from 120 miles south of Lanchow belong to *bakeri*. It is probable that the latter is the breeding form, and that *telephonus* is only a straggler in the Province.

53. CUCULUS OPTATUS Gould

Cuculus optatus GOULD, Proc. Zool. Soc. London, 1845, p. 18 (Port Essington, Australia).

One immature female, Yulo, 7,000 feet, Yunnan, August.

54. HIEROCOCCYX SPARVERIODES (Vigors)

Cuculus sparveriiodes VIGORS, Proc. Zool. Soc. London, 1832, p. 173 (Himalaya).

One male, Lapo-laze, north of Likiang, 10,000 feet, Yunnan, May, and one male, Muli Mountains, 10,000 feet, southwest Szechwan, June.

55. CACOMANTIS MERULINUS QUERULUS Heine

Cacomantis querulus HEINE, Journ. f. Orn., 1863, p. 352 (India, Nepal, Burma).

One male, Weihsi, 11,000 feet, northwest Yunnan, September.

¹² Nov. Zool., vol. 33, p. 236, 1926.

¹³ Ibis, 1924, p. 318.

¹⁴ Bull. Mus. Comp. Zool., vol. 68, p. 331, 1928.

¹⁵ Proc. U. S. Nat. Mus., vol. 77, art. 15, p. 13, 1930.

56. *CHALCITES MACULATUS MACULATUS* (Gmelin)

Trogon maculatus Gmelin, Systema naturae, vol. 1, pt. 1, p. 404, 1788 (Ceylon, error; Pegu).

One female, Noön forests, 11,000 feet, east of Muli, southwest Szechwan, August.

Family PSITTACIDAE, Parrots

57. *PSITTACULA SCHISTICEPS FINSCHI* (Hume)

Palaeornis finschi Hume, Stray Feathers, vol. 2, p. 509, 1874 (Kollidoo, Salwin River).

One adult male, two immature males, one adult female, and one immature female, Yulo, 7,000 feet, northwest Yunnan, August.

The adults are in molt. The tail is being renewed from the center outward, and in the female the plumage of the whole head and throat is being renewed and the two outer primaries on each side are coming in; the second primary is almost full grown; the outer primary is barely out of its sheath.

58. *PSITTACULA DERBIANA* (Fraser)

Palaeornis derbiana FRASER, Proc. Zool. Soc. London, 1850, p. 245, pl. 25 (cage bird).

Three males and one female, northwest Yunnan (Likiang-Yungning Lake, 10,200 feet, May; Lapo-laze, 9,000 feet, May); seven males and seven females, southwest Szechwan (Noön, east of Muli, 10,500 feet, August; Mount Gibboh, 13,000 feet, Muli, August; Shouchu Valley, 12,000 feet, August).

In this large series there is quite a little variation. The males have the chest and breast ranging from Hay's lilac to a dull violet-blue. The birds with the latter color have the head almost as deep a violet as the chest, only the forehead next to the black frontal band, around the eye, and lores being washed with bremen blue. This stage of plumage, I think, is that of the old males. The males with lilac chests have the pileum washed with greenish and are probably younger birds, but they probably breed in this plumage as their tails are much worn. In the female the range of color of the lower-parts is not so great as in the male, varying from dark lavender to light vinaceous-lilac. The forehead and the sides of the head are more extensively washed with bremen blue. The females have the maxilla black, while in the males it is scarlet. Unfortunately, for my theory of the lighter breasted male being a younger bird, there is a young male from Noön with maxilla black, only dull red at the base. The chest and breast are already quite dark, much darker

than the lilac-breasted male, but not so dark as dull violet-blue. It is just becoming slightly bluish on the crown, the rest of the pileum is washed with greenish, grayish olive on the occiput. Nevertheless, I think the lilac-breasted male a younger stage than the dull violet-blue male; these parts have somewhat faded in the former. The dull violet-blue-breasted male was taken in May, but it never would have faded to the lilac stage. There is naturally some variation, either individual or age.

Family MICROPODIDAE, Swifts

59. COLLOCALIA LOWI PELLOS Thayer and Bangs

Collocalia inopina pellos THAYER and BANGS, Mem. Mus. Comp. Zool., vol. 40, no. 4, p. 158, 1912 (Washan, west Szechwan).

One female, Noön forests, east of Muli, 11,000 feet, southwest Szechwan, August.

The above specimen agrees with skins from the type locality of the race. The wing measures 137 mm.

60. MICROPUS PACIFICUS PACIFICUS (Latham)

Hirundo pacifica LATHAM, Index ornithologicus, Suppl., p. 58, 1801 (Australia).

One unsexed, Petien or Barongomba, one day's trip northeast of Baurong, 11,000–12,000 feet, southwest Szechwan, no date.

61. HIRUNDAPUS NUDIPIES (Hodgson)

Chaetura nudipes HODGSON, Journ. Asiat. Soc. Bengal, vol. 5, p. 779, 1836 (Nepal).

One adult male, Shouchu Valley, 12,000 feet, southwest Szechwan, August.

This bird is very different in plumage from *Hirundapus caudacutus*, and their ranges apparently do not meet at any point. For these reasons it seems they should be treated as separate species. *Hirundapus nudipes* resembles *H. caudacutus* in color but is much darker throughout; the forehead is dark brown, only a little paler than the crown, not white; and it is larger. The above specimen has a wing 208 mm. long.

Family ALCEDINIDAE, Kingfishers

62. HALCYON PILEATA (Boddaert)

Alcedo pileata BODDAERT, Table planches des enluminées d'histoire naturelle de M. d'Aubenton, p. 41, 1783 (Canton, China).

One female, Yulinggong, 11,000 feet, 10 miles south of Tatsienlu, May.

63. *ALCEDO ATTHIS BENGALENSIS* Gmelin

Alcedo bengalensis Gmelin, *Systema naturae*, vol. 1, pt. 1, p. 450, 1788 (Bengal).

One male, Yungning Mountains, 12,000–13,000 feet, November–December; two males and one unsexed, Weihsi, 8,000–9,000 feet, Yunnan, September.

Family PICIDAE, Woodpeckers

64. *THRIPONAX FORRESTI* (Rothschild)

Dryocopus forresti ROTHSCILD, Bull. Brit. Orn. Club, vol. 43, p. 9, 1922 (Mekong Valley, Yunnan).

One male and one female, Ndamucho, 11,000 feet, Yunnan, October.

The specimen formerly recorded as an adult male¹⁸ was incorrectly sexed. It is an adult female. The above male resembles the same sex of *Thriponax richardsi* very closely. The only male specimen of the latter available for comparison has a broad space above the eye black, while in *forresti* the red of the crown reaches the eyelid posteriorly. This feature is not mentioned in the original description, and it may be only individual.

The female of *T. forresti* has the occiput red, while in the same sex of *T. richardsi* the whole crest is black without any red. Otherwise the two species are much alike superficially.

65. *PICOIDES FUNEBRIS* Verreaux

Picoides funebris VERREAUX, Nouv. Arch. Mus. Paris, vol. 6, Bull., p. 33, 1870 (mountains of Chinese Tibet).

Four males and five females, southwest Szechwan (Mount Mitzuga, 13,500 feet, Muli, June; back of Mount Mitzuga, 13,000 feet, June; Mount Konka, 14,000 feet, June; forests of Bonti, east of Waerhdje, 13,000 feet, July; Noön forests, 11,000 feet, east of Muli, August; Dshizhi, 13,500 feet, April; Mount Gibboh, 13,000–14,000 feet, April).

Only five of the above specimens are old adult birds. The rest are birds of the year in various stages of plumage, but none in the nestling stage. The youngest plumage of the male represented resembles the adult and has the yellow crown, but the breast and belly are without any white bars; the outer tail feathers have a few linear, irregular, white markings not quite reaching the margin distally; the white markings above are sparse; and the bill is shorter. As the bird becomes older, whitish bars appear below, the white markings increase above, and the white markings on the outer tail feathers become white ovoid spots mostly on the outer web, but one on the inner web, and a double spot subterminally, sepa-

¹⁸ Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 17, 1926.

rated by the black shaft. The next stage of the male is not represented, but it is carried on in one of the immature females where the white markings above and below are only a little less numerous than in the adult and the barring on the outer tail feathers with the white bars farther apart than in the adult and interrupted proximally; the pileum is without any white markings. Another female is acquiring white spots on the forehead.

66. *HYPOPICUS HYPERYTHRUS HYPERYTHRUS* (Vigors)

Picus hyperythrus VIGORS, Proc. Zool. Soc. London, 1831, p. 23 (Himalayan Mountains).

Four males and three females, southwest Szechwan (forests of Djago, Muli, 10,000–12,000 feet, June and April; forests of Baude-Shaya, 12,500–13,000 feet, northeast of Muli, July; Noön forests, 10,500 feet, east of Muli, August; Mount Gibboh, 13,000 feet, Muli, August; Chüchulongba, 13,000–14,000 feet, no date).

The above specimens are darker and brighter than the north China form, *Hypopicus hyperythrus subrufinus*. Two of the above specimens (male and female) are birds of the year with the underparts barred with black. The female taken in June has the throat and all the underparts barred; the male taken in August has the barring below much reduced and confined mostly to the chest and sides. One of the males in apparently adult plumage (Mount Gibboh, August) has the lower as well as the upper mandible black as in the immature specimens; it may be a bird of the year also.

67. *DRYOBATES MAJOR STRESEMANNI* Rensch

Dryobates major stresemanni RENSCH, Abh. Ber. Mus. Tierk. Volkerk. Dresden, vol. 16, no. 2, p. 38, 1924 (Tsalila, Szechwan).

One female, Yungning Mountains, 12,000–13,000 feet, Yunnan, November–December; three males and two females, southwest Szechwan (Muli Mountains, 10,000 feet, June; Djago, 11,200–12,000 feet, April; Shangentze, 14,500 feet, May; Chüchulongba, 13,000–14,000 feet, no date).

68. *DRYOBATES DARJELLENSIS DESMURSI* (Verreaux)

Picus desmursi Verreaux, Nouv. Arch. Mus. Paris, vol. 6, Bull., p. 33, 1870 (mountains of Chinese Tibet).

One adult male, Ndamucho, 14,000 feet, Yunnan, October.

The United States National Museum contains an adult female from Yunnan and another from Mount Omei, Szechwan. They do not seem to differ appreciably. Specimens of typical *D. darjellensis* are not available for comparison.

69. YUNGIPICUS SCINTILLICEPS CLEMENTII LaTouche

Yungipicus pygmaeus clementii LATOUCHE, Bull. Brit. Orn. Club, vol. 40, p. 51, 1919 (Chang-yang-hsien, Hupeh).

Four males and one female, northwest Yunnan (Likiang Mountains, 10,000 feet, January–February; Yulo, 7,000 feet, August; Fuchuanshan, 9,800 feet, September); one female, southwest Szechwan (forests of Shaya, 13,000 feet, northeast of Muli, July).

This series along with the four specimens previously recorded as *Yungipicus scintilliceps omissus*¹⁷ is darker and more heavily striped below than specimens from north China. Two males and one female from Yulo and a male from Fuchuanshan have a sulphur-yellow wash to the breast and belly not seen in the Likiang specimens, but a small series from Mount Omei almost exactly matches the Yulo specimens. One male and two females from Fukien, a male from Yochow, Hunan, and a male from Hsien-shan-hsien, Hupeh, are very similar in color to the Mount Omei birds. The lack of the yellow wash to the breast and belly in the Likiang specimens is due to fading, I believe, as they are birds taken late in spring or in summer, while those with the yellow wash are fall or early-winter birds. All the birds from Yunnan, Szechwan, Hupeh, Hunan, or Fukien before me are equally heavily striped below, and there does not appear to be any appreciable difference in size.

Seven males from northwest Yunnan measure: Wing, 99–106 mm. (101.6); culmen, 16.5–18 (17.7). Three males from Szechwan measure: Wing, 99.5–101.5 (100.3); culmen, 17–18 (17.3). Three males from Fukien, Hunan, and Hupeh measure: Wing, 100–101 (100.3); culmen, 18 mm.

This would seem to indicate that the dark-breasted birds are a southern race stretching right across south China from southern Szechwan to Fukien. If this is the true situation, then it seems LaTouche's name is to be used for it, as it has three years priority over *Dryobates pygmaeus omissus* Rothschild.¹⁸ Doctor Rensch¹⁹ has named a race from Kwanhsien, Szechwan, *Dryobates semicoronatus szetschuanensis*. I have not seen any specimens from as far north in Szechwan, but his measurements are only slightly smaller than what I get for the more southern bird, and his description seems very close also. He does not refer to *omissus* or *clementii*, but only compares his supposed race with the northern form, *scintilliceps*.

¹⁷ Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 16, 1926.

¹⁸ Bull. Brit. Orn. Club, vol. 43, p. 10, 1922.

¹⁹ Abh. Ber. Mus. Tierk. Völkerk. Dresden, vol. 16, no. 2, p. 39, 1924.

70. *PICUS CANUS SORDIDIOR* (Rippon)

Gecinus sordidiior RIPPON, Bull. Brit. Orn. Club, vol. 19, p. 32, 1906 (Yangtze Big Bend).

One male and one female, northwest Yunnan (Likiang Mountains, September; forests of Lapo-laze, 10,000 feet, May); four males and two females, southwest Szechwan (Yalung River Gorge, 11,000 feet, July; forests of Tyon-kong, Watogomba, 12,500 feet, Yalung watershed, July; Dshizhi, 13,500 feet, Muli, April; Chengtze, 14,500–15,900 feet, May).

The greens in this species quickly fade, so that by the end of the breeding season the green has mostly or entirely disappeared from the lowerparts and the upperparts, except the wings. This makes it necessary to compare specimens taken at approximately the same time or in the same state of wear. The female taken at Likiang in September almost matches a female taken south of Suifu in February in color and size. Though the series from Yunnan and Szechwan at my command is quite large, the majority of the specimens are in faded plumage and not good for comparison, but suitable for measurement. Ten males from northwest Yunnan and southwest Szechwan measure: Wing, 139–154 mm. (147.3); culmen, 33.5–40 (35.9). Six males from Suifu, Mount Omei, and north Szechwan, measure: Wing, 139–158 (147); culmen, 36.5–41 (38.3). When fresh unworn material is collected from northern Yunnan and western Szechwan and compared, I believe the supposed differences between the present race and *Picus canus setschuanus* Hesse²⁰ will largely disappear.

Family ALAUDIDAE, Larks

71. *OTOCORIS ALPESTRIS KHAMENSIS* Bianchi

Otocorys elvcesi khamensis BIANCHI, Ibis, 1904, p. 372 (Kham, southeastern Thibet).

Five males and two females, Yulonghsi Valley, 13,000–16,000 feet, May; two males and one female, Jesilongba Valley, 14,500–16,000 feet, May; two females, Jesila, 15,600–16,300 feet, May; one male, Konkalongba, Minya Mountains, 14,500 feet, no date; one male, Yulinggong, 10 miles south of Tatsienlu, 11,000 feet, May.

All the above localities are in Szechwan, to the south of Tatsienlu, from three to four days' trip to within 10 miles of the town.

I have no good material of the related forms with which to compare this series, except one male of *Otocoris alpestris przewalskii*. The latter is a paler and apparently smaller race with the black frontal band much reduced. *Otocoris alpestris khamensis* is a rather richly colored race above with the black frontal band and black

²⁰ Orn. Monatsb., vol. 19, p. 193, 1911.

coronal patch rather broad, the white separating these two areas rather narrow.

The ten males measure: Wing, 117-124 mm. (120.5); culmen, 13.5-15 (14); the five females: Wing, 111-114 (111.9); culmen, 13-14 (13.5).

Weigold took a series in the same general region that was assigned to this form by Doctor Hartert.²¹

72. *CALANDRELLA BRACHYDACTYLA DUKHUNENSIS* (Sykes)

Alauda dukhunensis SYKES, Proc. Zool. Soc. London, 1832, p. 93 (Deccan).

One male, Weihsi, 8,000-9,000 feet, northwest Yunnan, September.

Apparently not recorded from the Province before.

73. *ALAUDA GULGULA COELIVOX* Swinhoe

Alauda coelivox SWINHOE, Zoologist, 1859, p. 6724 (Amoy); Journ. North China Branch Roy. Asiat. Soc., no. 3, p. 288, Dec., 1859.

Alauda arvensis weigoldi HARTERT, Abh. Ber. Zool. Anthr.-Ethn. Mus. Dresden, vol. 15, no. 3, p. 20, 1922 (Hankow, Hupeh).

Two males and two females, northwest Yunnan (Likiang Mountains, 10,000 feet, January-February and September; Yungning Plain, 9,300 feet, May).

The wings of the above two males measure 100 and 103 mm.; the two females, 99 and 100. Another male taken on a previous trip in the Likiang Mountains in April has a wing measurement of 94 mm. Two males from the mouth of the Yangtze have wings measuring 100 and 100.5 mm.; one male from Yochow, Hunan, has a wing of 99 mm.; the wings of five males from southern Szechwan measure 90, 91.5, 93, 95.5, and 98 mm. Two males from Hongkong measure: Wing, 91 and 92 mm. Thus the supposed difference between the Yangtze Valley bird and that of southern China does not seem to hold good, but the material at hand from the latter locality is small and not conclusive.

Family HIRUNDINIDAE, Swallows

74. *PTYONOPROGNE RUPESTRIS* (Scopoli)

Hirundo rupestris SCOPOLI, Annus I historico naturalis, 1769, p. 167 (Tirol).

One male, Kere, south of Kulu, 9,000 feet, southwest Szechwan, December.

75. *DELICHON URBICA CASHMERIENSIS* Gould

Delichon cashmeriensis GOULD, Proc. Zool. Soc. London, 1853, p. 356 (Kashmir).

One male, Mutirong, 7,000-7,800 feet, Muli, southwest Szechwan, April.

²¹ Abh. Zool. Anthr.-Ethn. Mus. Dresden, vol. 15, no. 3, p. 21, 1922.

Specimens from the mountains of western China are somewhat smaller and have the tails less deeply forked than Kashmir birds; the latter are a clearer white below and also on the rump.

Family CAMPEPHAGIDAE, Cuckoo-shrikes

76. PERICROCOTUS BREVIROSTRIS ETHOLOGUS Bangs and Phillips

Pericrocotus brevirostris ethologus BANGS and PHILLIPS, Bull. Mus. Comp. Zoöl., vol. 58, p. 282, 1914 (Hsienshan, Hupeh).

Three males and four females, northwest Yunnan (Likiang Mountains, 10,000 feet, September; Mbayiwua, 10,000 feet, April; Lütien, 10,000 feet, September; Yulo, 7,000 feet, August); two males and two females, southwest Szechwan (Mount Mitzuga, 12,000 feet, Muli, June; Muli-Yunnan border, 11,000 feet, August).

Family DICRURIDAE, Drongos

77. CHIBIA HOTTENTOTA BREVIROSTRIS Cabanis

Chibia brevirostris CABANIS, Museum Heineanum, vol. 1, p. 112, 1850 (China).

One adult female, Tatsienlu, 9,500–10,000 feet, southwest Szechwan, May.

78. DICRURUS LEUCOPHAEUS NIGRESCENS Oates

Dicrurus nigrescens OATES, in Hume's Nests and Eggs, ed. 2, vol. 1, p. 208, 1889 (Rangoon).

Two males, one female, and one unsexed, northwest Yunnan (Likiang Mountains, January–February, September, and October; Luddü Mountains, 12,000–13,000 feet, August); one female, southwest Szechwan (Mount Mitzuga, 10,000 feet, Muli, June).

Family ORIOLIDAE, Old World Orioles

79. ORIOLUS CHINENSIS TENUIROSTRIS Blyth

Oriolus tenuirostris BLYTH, Journ. Asiat. Soc. Bengal, vol. 15, p. 48, 1846 (central India).

One adult male, one immature male, one adult female, and one immature female from northwest Yunnan (Likiang Mountains, September; forests west of Yungning, 12,000 feet, May; forests of Gowa, 10,000 feet, May).

Family CORVIDAE, Crows

80. NUCIFRAGA CARYOCATACTES MACELLA Thayer and Bangs

Nucifraga hemispila macella THAYER and BANGS, Bull. Mus. Comp. Zoöl., vol. 52, p. 140, 1909 (Hsien-shan-hsien, Hupeh).

Five males and two females, northwest Yunnan (Likiang Mountains, 10,000 feet, January–February and September; Tokesher-Lapo,

10,000 feet, May; Ndamucho, 14,000 feet, October); three males and four females, southwest Szechwan (Mount Mitzuga, 13,500 feet, Muli, June; forests of Tyon-kong, Watogomba, Yalung watershed, July; Noön Valley, 10,000 feet, east of Muli, August).

81. *PYRRHOCORAX PYRRHOCORAX HIMALAYANUS* (Gould)

Fregilus himalayanus GOULD, Proc. Zool. Soc. London, 1862, p. 125 (Himalayas).

One female, Mount Konka, 16,000 feet, southwest Szechwan, June.

82. *UROCISSA ERYTHORHYNCHA ERYTHORHYNCHA* (Boddaert)

Corvus erythrorhynchus BODDAERT, Table planches des enluminées d'histoire naturelle de M. d'Aubenton, p. 38, 1783 (China).

Two males and one female, northwest Yunnan (Likiang Mountains, 10,000 feet, January–February, and Yungning Mountains, 12,000–13,000 feet, November–December).

83. *GARRULUS BISPECULARIS SINENSIS* Swinhoe

Garrulus sinensis SWINHOE, Proc. Zool. Soc. London, 1863, p. 304 (Canton to Ningpo).

Two males and three females, southwest Szechwan (mountains south of Muli, 10,500 feet, December; between Tsoo and Kulu, 10,500 feet, December; Muli Mountains, 10,000 feet, June; Mount Mitzuga, 12,500 feet, Muli, June; back of Mount Mitzuga, 10,000 feet, June).

This series compared with a series from Fukien and Chekiang substantiates the remarks made previously.²² The western birds average more grayish on the mantle. Immature specimens are much more rufescent than the adult and lack the grayish cast to the mantle. Some specimens, apparently adult, taken in winter are more rufescent than others, and the grayish cast to the mantle is almost lacking. It might be that these are birds of the year in their first winter plumage.

84. *COLOEUS DAURICUS KHAMENSIS* Bianchi

Coloeus dauricus khamensis BIANCHI, Bull. Brit. Orn. Club, vol. 16, p. 68, 1906 (Mekong River, Kham, southeast Tibet).

One female, Likiang Mountains, 10,000 feet, January–February; and one male and two females, Weihsi, 8,000–9,000 feet, northwest Yunnan, September.

85. *COLOEUS FUSCICOLLIS* (Vieillot)

Corvus fuscicollis VIEILLLOT, Tableau encyclopédique et méthodique des trois règnes de la nature . . . Ornithologie, vol. 2, p. 380, 1823 (Lake Baikal).

Corvus neglectus SCHLEGEL, Bijdr. Dierk., Amsterdam, afl. 8, Corvus, p. 16, 1859 (Japan).

²² Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 64, 1926.

Two males and two females, Ndamucho, 14,000 feet, northwest Yunnan, October.

LaTouche²³ unites *dannuricus* and *fuscicollis* as other authors have done, but admits that he has no proof that they are the same and presents evidence for and against such a view. It is quite possible that the black bird, *fuscicollis*, and the pied, *dannuricus*, are only phases of the same species, but until this is proved to be undoubtedly the case the records had, in my opinion, better be kept separate. If the two are only color phases, it is rather queer that intermediates apparently are never or rarely found.

Stresemann²⁴ has called attention to the precedence Vieillot's name has over that of Schlegel. Lord Rothschild²⁵ regards the present bird as a dimorphic form of *dannuricus*.

Family PARADOXORNITHIDAE, Parrot-bills

86. CONOSTOMA AEMODIUM AEMODIUM Hodgson

Conostoma aemodius Hodgson, Journ. Asiat. Soc. Bengal, vol. 10, p. 857, 1841 (Nepal).

Two males, six females, and one unsexed, Ndamucho, Yangtze-Mekong Divide, 14,000 feet, northwest Yunnan, October.

No specimens are available from the Himalayas or western Szechwan. The present series is referred to the above race on geographic grounds, rather than to *Conostoma aemodium bambuseti* Stresemann²⁶ from Washan, Szechwan. Since the above was written an adult male has been received from the Rev. David C. Graham taken in Mupin. It is somewhat darker below and on the occiput; the differences are not great, however.

The two males from Yunnan measure: Wing, 138.5–139 mm.; tail, 140–144; culmen, 26–26. The six females from Yunnan: Wing, 125.5–137.5 (131); tail, 137.5–145 (141.9); culmen, 22.5–25 (24). The single male from Mupin: Wing, 123.5; tail, 132; culmen, 22.

This would seem to indicate that the more northern bird is somewhat smaller, but one specimen, sexed by a native, is not sufficient to pass judgment on the validity of a race.

87. SUTHORA UNICOLOR CANASTER Thayer and Bangs

Suthora unicolor canaster THAYER and BANGS, Mem. Mus. Comp. Zool., vol. 40, no. 4, p. 171, 1912 (Mount Washan, Szechwan).

Four males, four females, and one unsexed, Yunnan (Likiang Mountains, 10,000 feet, January–February; Luddü Mountains, 12,000–13,000 feet, August; Ndamucho, 14,000 feet, October); two

²³ Handbook of Birds of East China, pt. 1, p. 11, 1925.

²⁴ Anz. Orn. Ges. Bayern, no. 2, p. 8, 1919.

²⁵ Nov. Zool., vol. 33 p. 341, 1926.

²⁶ Journ. Orn., 1923, p. 366.

males, five females, and two unsexed, Szechwan (Dshizhi, north of Kulu and west of the Yalung, 13,500 feet, April; Mount Gibboh, 13,000 feet, Muli, December).

88. *SUTHORA FULVIFRONS CYANOPHRYS* David

Suthora cyanophrys DAVID, Journ. Trois Voy. Emp. Chin., vol. 1, p. 345, 1875 (Chensi méridion.).

Three males and three females, Ndamucho, Yangtze-Mekong Divide, 14,000 feet, northwest Yunnan, October; one male, Dshizhi, north of Kulu and west of the Yalung, 13,500 feet, southwest Szechwan, April.

This race is quite distinct from *Suthora fulvifrons fulvifrons* in being much lighter in color, the dark bands on each side of the crown being slaty gray, instead of tawny-olive, and there are other differences. I have never seen a specimen from Shensi and do not believe any have been taken there in recent years.

89. *SUTHORA WEBBIANA RICKETTI* (Rothschild)

Paradoxornis webbiana ricketti ROTHSCHILD, Bull. Brit. Orn. Club, vol. 43, p. 11, 1922 (Yangtze Valley, Yunnan).

One adult male and four females or immature males (two marked males, the remainder unsexed), northwest Yunnan (Luddü Mountains, 12,000–13,000 feet, August; Yulo, west of the Likiang Mountains, 7,000 feet, August); one male and one female, southwest Szechwan (Yanwekong, 10,700 feet, May).

The adult male has a much larger bill than the female. These do not exactly agree with the original description. The chest and throat have a slight vinaceous-fawn cast, though in the younger specimens they are white. I have not been able to examine a specimen of *Suthora webbiana styani*, but I am under the impression that it and the present race do not belong to the *webbiana* group.

Family PARIDAE, Titmice

90. *AEGITHALOS GLAUCOGULARIS VINACEA* (Verreaux)

Mecistura vinacea VERREAUX, Nouv. Arch. Mus. Paris, vol. 6, Bull., p. 39, 1870 (mountains of Chinese Tibet); Nouv. Arch. Mus. Paris, vol. 7, Bull., p. 76, 1871 (type from Ourato).

Two males, Likiang Mountains, 10,000 feet, Yunnan, January–February.

When two specimens were recorded from the Lashipa Plain, Yunnan,²⁷ Rothschild²⁸ questioned the identification, thinking they

²⁷ Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 50, 1926.

²⁸ Nov. Zool., vol. 33, p. 396, 1927.

must belong to *A. g. glaucogularis*. They were identified correctly, however, as later material has proved. The United States National Museum contains a good series of *A. g. glaucogularis*, and it is a much smaller bird with a shorter wing and much shorter tail. The two Yunnan specimens listed above measure: Wing, 68–66 mm.; tail, 78–73. Bangs and Peters²⁹ record this race from the mountains of Kansu and Tebbuland, so it seems that it is the resident race of the high mountains of western China as far south as northern Yunnan and occurring also in northern China.

91. AEGITHALISCUS BONVALOTI (Oustalet)

Acredula bonvaloti OUSTALET, Ann. Sci. Nat., Zool., ser. 7, vol. 12, p. 286, pl. 9, fig 1, 1891 (Tatsienlu and Pendjama, Szechwan).

Twenty-seven adults, both sexes, northwest Yunnan (Likiang Mountains, January–February, September and October; forests west of Yungning, 13,000 feet, May; forests of Chinhaize, 11,000 feet, May; Gou-khü-ko, 13,000 feet, Yangtze loop, April; Luddü Mountains, 12,000–13,000 feet, August); six adults and nine immatures, southwest Szechwan (Mount Mitzuga and vicinity, 13,000 feet, June; forests of Djishigotong, northeast of Muli, 13,000 feet, July; forests of Tyon-kong, Watogomba, 12,000 feet, July; Dzampe, Muli, 14,000 feet, July).

The fine series of immatures in the present collection confirms my former doubtful action in assigning a single specimen of this plumage to the present species.³⁰ The immature plumage differs from that of the adult as there described.

92. AEGITHALISCUS CONCINNUS TALIFUENSIS Rippon

Aegithaliscus talifuensis RIPPON, Bull. Brit. Orn. Club, vol. 14, p. 18, 1903 (Gyi-dzin-shan, east of Talifu, Yunnan).

One female and one unsexed, Yulo, west of the Likiang Mountains, 7,000 feet, August; and one unsexed, Luddü Mountains, 12,000–13,000 feet, August, northwest Yunnan.

93. PERIPARUS RUFONUCHALIS BEAVANI (Jerdon)

Lophophanes beavani JERDON (Blyth MS.), Birds of India, vol. 2, p. 275, 1863 (Mount Tongloo, Sikkim).

Two females from northwest Yunnan (Likiang Mountains, 10,000 feet, January–February; Luddü Mountains, 12,000–13,000 feet, August); two males, one female, and three immatures from southwest Szechwan (Mount Mitzuga, 12,000 feet, June; forests of Noön,

²⁹ Bull. Mus. Comp. Zool., vol. 68, p. 363, 1928.

³⁰ Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 50, 1926.

10,500 feet, east of Muli, August; alpine region of Zimi Valley, 15,000 feet, August; Yulinggong, 11,000 feet, May).

94. *PERIPARUS ATER AEMODIUS* (Hodgson)

Parus aemodius HODGSON, Journ. Asiat. Soc. Bengal, vol. 13, p. 943, 1844 (Nepal).

One adult male, Likiang Mountains, 10,500 feet, Yunnan, September; one young not long from the nest, alpine region of Zimi Valley, 15,000 feet, west of Waerhdje, southwest Szechwan, August.

95. *LOPHOPHANES DICHROUS WELLSI* (Baker)

Parus dichrous wellsi BAKER, Bull. Brit. Orn. Club, vol. 38, p. 8, 1917 (Yangtze Big Bend, west Yunnan).

Four males, three females, and one unsexed from northwest Yunnan (Likiang Mountains, 10,000–11,000 feet, January–February and September; Gou-khü-ko, Yangtze loop, 13,000 feet, April; forests of Yungning, 13,000 feet, May, Luddü Mountains, 12,000–13,000 feet, August; five males, one female, and two unsexed from southwest Szechwan (Mount Mitzuga, Muli, 13,000 feet, June; back of Mount Mitzuga, 12,000 feet, June; forests of Djishigotong, Yalung Basin, 13,000 feet, July; alpine region of Zimi Valley, 15,000 feet, west of Waerhdje, August; Ronopien region, west of Waerhdje, 15,000 feet, August; Mudju, 11,000 feet, June).

96. *PENTHESTES PALUSTRIS DEJEANI* (Oustalet)

Parus dejeani OUSTALET, Bull. Mus. Paris, vol. 3, p. 209, 1897 (Tatsienlu, Szechwan).

Two males and two females from northwest Yunnan (Likiang Mountains, 10,000 feet, January–February; Luddü Mountains, 12,000–13,000 feet, August; Ndamucho, Yangtze-Mekong Divide, 14,000 feet, October); three males, three females, and one unsexed southwest Szechwan (forests of Bonti, east of Waerhdje, 12,500 feet, July; Watogomba, 12,500 feet, July; forests of Djishigotong, Yalung Basin, 13,000 feet, July; Mount Gibboh, 13,000 feet, south of Muli, August; forests of Noön, 10,500 feet, east of Muli, August).

The specimen formerly recorded as of this form from Shanghai³¹ was an error; it is *Penthestes palustris hellmayri*, as more ample material since received proves. *Penthestes palustris dejeani* and *Penthestes palustris hellmayri* are much alike; the former differs only in being somewhat darker above and on the flanks. Three of the specimens taken in July have the backs very dark, more of a brown than gray, the flanks more strongly washed with drab, and

³¹ Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 43, 1926.

the pileum more brownish, not so glossy a black. These are probably immature.

97. *PENTHESTES SUPERCILIOSA* (Przewalski)

Poecile superciliosa PRZEWALSKI, Mongol i strana Tangut, vol. 2, p. 53, 1876 (Alpine region of the mountains of Kansu); Rowley's Ornithological miscellany, vol. 2, p. 189, 1877 (translation).

One adult male of this rare chickadee, Yulonghsi, 13,000–16,000 feet, Szechwan, May.

98. *PARUS MAJOR TIBETANUS* Hartert

Parus major tibetanus HARTERT, Die Vögel der paläarktischen Fauna, vol. 1, Heft 3, p. 346, 1905 (Chaksam, Tsongpo Valley, Tibet).

Eight males and one female from northwest Yunnan (Likiang Mountains, 10,000–12,000 feet, January–February; forests west of Yungning, 12,000 feet, May); one male and one female from southwest Szechwan (Mutirong, 7,000–7,800 feet, Muli, April; Shangentze, south base of Druduron Pass, 14,500 feet, May).

In a former paper³² I assigned specimens from the vicinity of Suifu to *tibetanus*. This was a mistake; specimens from there belong to *artatus*; *tibetanus* is the form occurring at higher elevations and has the outer tail feathers more extensively white. The two forms do not differ greatly, however.

99. *PARUS MONTICOLUS YUNNANENSIS* LaTouche

Parus monticolus yunnanensis LATOUCHE, Bull. Brit. Orn. Club, vol. 42, p. 51, 1922 (Milati, Yunnan).

One female and one adult unsexed from northwest Yunnan (mountains of Yungning, 12,000–13,000 feet, November–December, and Shintsang, west of Weihsi, 11,000 feet, September); four males and one female from southwest Szechwan (forests of Vudju, south of Muli, 10,000 feet, May; forests of Baude-Shaya, northeast of Muli, 12,500 feet, July; Noön forests, east of Muli, 10,500 feet, August; Mutirong, 7,000–7,800 feet, April; Yanwekong Valley, 10,000–12,000 feet, May).

Family SITTIDAE, Nuthatches

100. *SITTA YUNNANENSIS* Grant

Sitta yunnanensis GRANT, Bull. Brit. Orn. Club, vol. 10, p. 37, 1900 (Weiyuan, south Yunnan).

Fifteen adults, both sexes, from northwest Yunnan (Likiang Mountains, 10,000 feet, January–February; mountains of Yungning,

³² Proc. U. S. Nat. Mus., vol. 77, art. 15, p. 21, 1930.

12,000–13,000 feet, November–December; Lautsolö Gorge, 9,000 feet, April; Luddü Mountains, 12,000–13,000 feet, August); two females from southwest Szechwan (Vudju Mountains, 10,500 feet, May).

This very distinct species resembles *Sitta villosa* of north China in general appearance, but there are numerous differences. *S. yunnanensis* has a black line on the side of the head from the lores through the eye to the nape with a narrow white superciliary above it, the pileum bluish gray, while in the fully adult male *S. villosa* the whole top of the head is black with a white superciliary; the latter is a smaller bird.

The tail of *S. yunnanensis* is somewhat variable. The white on the outer tail feathers is reduced to a mere subterminal spot on the inner web in some specimens, while in others it is a narrow diagonal subterminal bar, extending across the feather.

101. *SITTA SINENSIS NEBULOSA* LaTouche

Sitta europaea nebulosa LATOUCHE, Bull. Brit. Orn. Club, vol. 42, p. 55, 1922 (new name for *Sitta europaea obscura* preoccupied; Milati, Yunnan).

Seventeen adults, both sexes, from northwest Yunnan (Likiang Mountains, January–February, September, and October; mountains of Yungning, 12,000–13,000 feet, November–December; forests west of Yungning, 13,000 feet, May; forests of Lapo-laze, 10,000 feet, May; Tokesher, 10,000 feet, May; Luddü Mountains, 12,000–13,000 feet, August; Fuchuanshan, 10,000–12,000 feet, September; Ndamucho, 14,000 feet, October); 10 adults, both sexes from southwest Szechwan (Muli River Valley, 9,800 feet, May; Mount Mitzuga, 13,000 feet, June; Shouchu Valley, near Dzeru, 11,300 feet, August; Noön Valley, east of Muli, 10,500 feet, August; Mount Gibboh, 13,000 feet, Muli, May and August).

102. *SITTA MAGNA* Ramsay

Sitta magna RAMSAY, Proc. Zool. Soc. London, 1876, p. 677 (Karennnee).

One female, Mbayiwua, 10,000 feet, Yangtze loop, Yunnan, April.

Family CETHIIDAE, Creepers

103. *CERTHIA HIMALAYANA YUNNANENSIS* Sharpe

Certhia yunnanensis SHARPE, Bull. Brit. Orn. Club, vol. 13, p. 11, 1902 (Shayang, west Yunnan).

Two adult males, one adult female, and one immature, not sexed, southwest Szechwan (Muli Mountains, Litang River Valley, 10,000 feet, May; Mount Mitzuga, Muli, 13,000 feet, June; Yetsi Valley, north of Kulu, 12,000 feet, April; Mudju, 11,000 feet, June), and one adult female, northwest Yunnan (Luddü Mountains, 12,000–13,000 feet, August).

Two winter specimens from Chengtu, Szechwan, have a more rusty tinge to the upperparts.

104. *CERTHIA FAMILIARIS KHAMENSIS* Bianchi

Certhia khamensis BIANCHI, in Sharpe's Handlist of the genera and species of birds, vol. 4, pp. 355, 360, 1903 (Kansu; Szechwan; southeast Tibet).

One adult unsexed from Yunnan (Likiang Mountains, 10,000 feet, January–February); one male and one unsexed from southwest Szechwan (Mount Gibboh, Muli, 13,000 feet, May; Mount Mitzuga, Muli, 13,000 feet, June).

105. *TICHODROMA MURARIA* (Linnaeus)

Certhia muraria LINNAEUS, Systema naturae, ed. 12, p. 184, 1766 (south Europe).

One male, Mount Konka, 15,700 feet, August; and one female, Djago, 11,200–12,000 feet, April, both in Muli, southwest Szechwan.

Family TIMALIIDAE, Babbling Thrushes

106. *IANTHOCINCLA MAXIMA* (Verreaux)

Pterorhinus maximus VERREAUX, Nouv. Arch. Mus. Paris, vol. 6, Bull., p. 36, pl. 3, fig. 1, 1870 (mountains of Chinese Tibet).

Three males and two females, northwest Yunnan (Likiang Mountains, 10,000 feet, January–February, and Ndamucho, 14,000 feet, October); seven males, five females, one unsexed, and one immature, southwest Szechwan (Muli, 10,000 feet, December; Mount Mitzuga, 12,500 feet, June; back of Mount Mitzuga, 12,000–13,000 feet, June; Mount Konka, 14,600 feet, June; forests of Bonti, east of Waerhdje, 12,500 feet, July; Mount Gibboh, 12,500–14,000 feet, south of Muli, August and April; Zimi Valley, 14,600 feet, west of Waerhdje, August; Chiu-lung-hsien, May; Shangentze, 14,500 feet, at the foot of Druduron Pass, May).

The immature bird is not long from the nest and was taken in June. The plumage is almost a duplicate of that of the adult. The hazel of the throat and ear coverts is considerably lighter; the neutral gray bases of the feathers of the jugulum show through, making a dark patch and the middle tail feathers are warm sepia. An older specimen, but a bird of the year, taken in July, has the colors of the throat and ear coverts deepened; and the neutral gray jugular patch more pronounced.

107. *IANTHOCINCLA BIETI* Oustalet

Ianthocincla bieti OUSTALET, Bull. Mus. Paris, vol. 3, p. 163, 1897 (Tatsienlu, Szechwan).

One male, Ndamucho, 14,000 feet, Yunnan, October; and one female, Mount Gibboh, 13,000–14,000 feet, Muli, Szechwan, April.

The above female differs from any in the series previously reported upon³³ as follows: The pileum is bister; the throat and upper chest a light clove brown; the feathers of the sides of the neck and chest merely fringed narrowly with white; the flank feathers without the subterminal black bar; and there are other differences. Whether these differences are sexual can not be determined, but I am inclined to the belief that they are age characters. The females in Doctor Rock's earlier collection only differ from the males in being duller, if they differ at all.

108. *BABAX LANCEOLATUS LANCEOLATUS* (Verreaux)

Pterorhinus lanceolatus VERREAUX, Nouv. Arch. Mus. Paris, vol. 6, Bull., p. 36, 1871 (mountains of Chinese Tibet).

Two males and two females, northwest Yunnan (Likiang Mountains, 10,000 feet, January–February and September; Ndamucho, 14,000 feet, October); five males and six females, southwest Szechwan (forests of Watogomba, 12,500 feet, Yalung watershed, July; forest of Djishi, 11,000 feet, northeast of Muli, July; forests of Noön, 10,500 feet, east of Muli, August; mountains of Kulu, 11,000 feet, December; Brüolo-kong Valley, 13,000–15,900 feet, eight days southwest of Tatsienlu, May; Shangentze, 14,500 feet, May; Yuling-gong, 11,000 feet, May).

With a much larger series before me than when Doctor Rock's former collection from Yunnan was reported upon,³⁴ I am unable to recognize *bonvaloti* as a valid race. The single specimen from Hupeh marked as a male upon which my remarks upon size were founded, I am convinced now is wrongly sexed and that it is really a female. The female is considerably smaller than the male. Since that paper was written, females have been received from Szechwan and Yunnan that are as small as the Hupeh specimen in question.

109. *GARRULAX ALBOGULARIS EOUS* Riley

Garrulax albogularis eous RILEY, Proc. Biol. Soc. Washington, vol. 43, p. 78, 1930 (Fuchuanshan, Yunnan).

Four males and two females, Fuchuanshan, 9,800 feet, Yunnan, September.

This race was described as follows:

Similar to *Garrulax albogularis albogularis*, but much lighter above, the forehead more strongly and extensively tinged with tawny; the cinnamon-buff of the breast lighter; the chest band a lighter brownish olive. Wing, 136; tail, 136; culmen, 22; tarsus, 43; middle toe, 24 mm.

³³ Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 25, 1926.

³⁴ Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 23, 1926.

The above series is quite uniform and differs as described from an unsexed specimen from Nepal. When the original description was published, the United States National Museum only had four poor specimens from Szechwan. The Rev. David C. Graham has since sent to the Museum nine fine adults taken on Mount Omei, Szechwan. These are darker than *eous*, but lighter than *albogularis*. On the whole the bird from Szechwan is nearer the race from Nepal (*albogularis*) than that from Yunnan (*eous*). The Szechwan form has been named *Garrulax albogularis laetus*.³⁵ Stresemann³⁶ has reported it from as far north in the mountains of Szechwan as Kwan.

110. DRYONASTES SANNIO (Swinhoe)

Garrulax sannio SWINHÖE, Ibis, 1867, p. 403 (Amoy, China).

Six males and seven females, northwest Yunnan (Likiang Mountains, January–February, and September; Yulo, 7,000 feet, August; Weihsí, 8,000–9,000 feet, September; Ndamucho, 14,000 feet, October); one female without locality or date.

With a larger series than formerly at my disposal³⁷ I am inclined to agree with Rothschild³⁸ in not recognizing *albosuperciliaris*, but I have not examined many specimens from Fukien. Birds from southern Szechwan (Suifu and Kiating) are darker above and below than either the Yunnan or Fukien specimens, but it is inadvisable to separate them by name.

111. DRYONASTES BERTHEMYI RICINUS Riley

Dryonastes berthemyi ricinus RILEY, Proc. Biol. Soc. Washington, vol. 43, p. 80, 1930 (Ndamucho, Yunnan).

One male and two females, Ndamucho, 14,000 feet, Yunnan, October.

These three specimens, when compared with an equal number from the type locality of *berthemyi*, Kuatun, Fokien, may be described as follows:

Similar to *Dryonastes berthemyi* of the mountains of Fokien, but lighter brown above and on the foreneck and jugulum; breast and belly a much lighter gray. Wing, 126; tail, 132; culmen, 20; tarsus, 42; middle toe, 24.5 mm.

In the original description, I said that *Dryonastes berthemyi* had never been taken away from the mountains of northwest Fokien, overlooking for the moment Stresemann's³⁹ record of a specimen from Mount Omei, Szechwan. This specimen is probably the same

³⁵ Proc. Biol. Soc. Washington, vol. 43, p. 133, 1930.

³⁶ Abh. Ber. Mus. Tierk. Völk. Dresden, vol. 16, no. 2, p. 25, 1924.

³⁷ Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 27, 1926.

³⁸ Nov. Zool., vol. 33, p. 267, 1926.

³⁹ Abh. Ber. Mus. Tierk. Völk. Dresden, vol. 16, no. 2, p. 24, 1924.

as that from Yunnan or will later be found to differ and need naming.

The type of *Dryonastes berthemyi* came from the mountains of northwest Fokien, probably Kuatun. It is rather surprising to find a closely related form in the high mountains of northwest Yunnan, more than 1,000 miles from the type locality of the species. Ndamucho is south of Lütien on the Yangtze-Mekong Divide. The United States National Museum contains an adult female of *Dryonastes berthemyi* from the type locality, and the Museum of Comparative Zoölogy has loaned me a pair from near the same place; the three specimens are quite uniform. The three specimens from northwest Yunnan are also quite uniform and differ from the Fokien bird as described. The three specimens from Yunnan measure: Wing, 120-128 mm. (124); tail, 125-132 (128); culmen, 20-22 (20.7). Two females and one male from Fokien measure: Wing, 116-118 (116.8); tail, 122-126 (123.5); culmen, 22.5-23 (22.7).

LaTouche⁴⁰ makes *berthemyi* a race of *poecilorhynchus* of Formosa, but I do not think he is right in doing so. They have both been derived from the same stock, but now are so distinct that it is misleading to treat them as forms of the same species.

112. POMATORHINUS RUFICOLLIS SIMILIS Rothschild

Pomatorhinus ruficollis similis ROTHSCHILD, Nov. Zool., vol. 33, p. 261, 1926 (Tengyueh, Yunnan).

Three males and four females, northwest Yunnan (Likiang Mountains, January-February and September; mountains of Yungning, November-December; upper slopes of the Fuchuanshan, 10,000-12,000 feet, September; Weihsi, 8,000-9,000 feet, September; Ndamucho, 14,000 feet, October); one female, southwest Szechwan (Muli Valley, 9,500 feet, June).

This is quite a distinct race, Saccardo's umber above; quite different from *Pomatorhinus ruficollis eidos* from Yangtze Valley farther east, which is strongly tinged with rufous above and has a smaller bill. The latter occurs in two ventral color phases: one in which the chest streaks are rufous and the other in which they are brownish olive, but no matter which phase the specimen is in, the upperparts are strongly tinged with rufous. *P. r. similis* is quite uniform in series and does not vary much; specimens from the Mekong Valley are Saccardo's umber above, while those from the Likiang Mountains are light brownish olive. Just where the ranges of *similis* and *eidos* meet it is impossible to say. The United States National Museum has the latter from the Szechwan border south of Suifu, Mount Omei, and the vicinity of Suifu, but not from farther west.

⁴⁰ Handbook of Birds of East China, pt. 1, p. 57, 1925.

P. n. similis was formerly recorded as *P. n. bakeri*⁴¹ from Yunnan, following Rothschild's earlier papers, as no authentic specimens from Burma were available for comparison.

113. POMATORHINUS ERYTHROGENYS DEDEKENSI Oustalet

Pomatorhinus macclellandi var. *dedekensi* OUSTALET, ANN. Sci. Nat. Zool., ser. 7, vol. 12, pp. 276, 304, 1892 (Tsonghai, Tibet and Tatsienlu, Szechwan).

Thirteen adults, both sexes, northwest Yunnan (Likiang Mountains, January–February and October; Yulo, 7,000 feet, August; Ndamucho, 14,000 feet, October); two males and six females, southwest Szechwan (Muli Valley, 10,000 feet, June; Muli Mountains, 10,000 feet, June; Mount Mitzuga, 12,500 feet–13,000 feet, Muli, June; Dzampe 14,000 feet, Muli, July; Djago, 11,200–12,000 feet, April; Tatsienlu, 9,500–10,000 feet, May); one female, without locality.

The variations in a large series of this race are considerable. The specimens taken in the winter are light brownish olive above; by summer they become hair brown by fading. The male has a longer bill than the female. Three adults from Tatsienlu taken in the breeding season do not differ appreciably from three adults taken at the same season in Muli.

In reporting on Doctor Rock's former collection from Yunnan⁴² four specimens from the Mekong Valley were listed without specific comment. These four specimens have the black streaks on the chest very pronounced, especially in a male, U. S. N. M. No. 296712, which has even the breast spotted quite heavily with black spots, but as some of the specimens from farther north approach the lightest marked Mekong Valley specimen very closely, these heavily streaked birds had better be regarded as individual variations for the present.

Two females from Mount Mitzuga are evidently birds of the year in nearly adult plumage; their bills are remarkably short, 23 and 24 mm. against an adult measurement of 32–35.

114. TROCHALOPTERON ELLIOTII ELLIOTII Verreaux

Trochalopecteron elliotii VERREAUX, Nouv. Arch. Mus. Paris, vol. 6, Bull., p. 36, 1870 (mountains of Chinese Tibet).

Twelve males, eight females, and one immature not sexed, northwest Yunnan (Likiang Mountains, January–February, and September; Mountains of Yungning, 12,000–13,000 feet, November–December; Ndamucho, 14,000 feet, October; Luddü Mountains, 12,000–13,000 feet, August); 11 males and 6 females, southwest Szechwan

⁴¹ Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 26, 1926.

⁴² Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 27, 1926.

(Muli, 10,500 feet, December; back of Mount Mitzuga, 12,000 feet, Muli, June; Mount Gibboh, 13,000 feet, Muli, August; Baude Mountains, 10,000 feet, northeast of Muli, July; Tyon-kong, Watogomba, Yalung watershed 12,000 feet, July; Djago, 10,400–12,000 feet, between Muli and Kulu, December and April; Vudju, 10,000 feet, south of Mount Gibboh, April; Dshizhi, 13,500 feet, April; Yanwekong, 10,000–12,000 feet, May; Yulonghsi, 13,000–16,000 feet, May; Mudju, 11,000 feet, June; Yulinggong, 11,000 feet, May; Tatsienlu, 9,500–10,000 feet May).

This species is much subject to fading. Specimens taken in the winter are much darker even than birds collected in early spring. The winter taken birds in the above series are dark like winter taken specimens from Szechwan. It will be noted that the series I formerly determined to be *Trochalopteron ellioti yunnanense*⁴³ are spring or summer taken birds with the exception of several immatures. When breeding birds from Szechwan are compared with these spring taken, the lighter color of the supposed Yunnan race largely disappears. The gray or yellow middle tail feathers are also due to fading to some extent. All the specimens with gray middle tail feathers are in faded or worn plumage, but not all specimens in worn plumage have gray middle tail feathers. This is natural; it is well known some individuals of a species wear or fade quicker than others. There are a number of specimens in worn plumage in the United States National Museum from Szechwan with gray middle tail feathers. Taking all the above into consideration, I do not now believe that *Trochalopteron ellioti yunnanense* can be maintained as a valid race. Therefore *Garrulax elliotii exyunnanensis* Meinertzhagen⁴⁴ proposed to supplant Rippon's name is unnecessary.

115. TROCHALOPTERON AFFINIS OUSTALETI (Hartert)

Ianthocincla affinis oustaleti HARTELT, Die Vögel der palaarktischen Fauna, vol. 1, Heft 5, p. 633, 1909 (Tsekou, Yunnan).

One male, southwest Szechwan (Litang River Valley, 9,900 feet, Muli, April); four males and four females, northwest Yunnan (Likiang Mountains, 10,000 feet, January–February; mountains of Yungning, 12,000–13,000 feet, November–December; Ndamucho, 14,000 feet, October).

With a larger series of *T. a. blythi* before me than I formerly had available,⁴⁵ the only constant difference between it and *T. a. oustaleti* seems to be the absence of the gray patch on the sides of the neck of the former. Just where the two forms meet, I do not know, but it must be somewhere in the mountains of western Szechwan.

⁴³ Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 24, 1926.

⁴⁴ Ibis, 1928, p. 510.

⁴⁵ Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 24, 1926.

116. *TROCHALOPTERON STYANI* Oustalet

Trochalopteron styani OUSTALET, Bull. Mus. Paris, vol. 4, p. 226, 1898 (Tatsien-lou, Szechwan).

One male and five females from southwest Szechwan (Muli Mountains, 10,000 feet, June; Noön Valley, 10,000 feet, east of Muli, August); two males, three females, and one unsexed, northwest Yunnan (Fuchuan Shan, 10,000–12,000 feet, September; Weihsi, 11,000 feet, September; Ndamucho, 14,000 feet, October).

These agree with specimens previously reported upon from Yunnan.⁴⁶

117. *FULVETTA STRIATICOLLIS YUNNANENSIS* (Rothschild)

Proparus striaticollis yunnanensis ROTHSCILD, Bull. Brit. Orn. Club, vol. 43, p. 11, 1922 (Mekong-Salwin Divide, Yunnan).

One male and one female, mountains of Kulu, 11,000 feet, December; one male and one female, Muli, 10,500 feet, December; one male, Muli Mountains, 10,000 feet, June; two males and one female, Mount Mitzuga, Muli, 12,000–14,500 feet, June; one female and one unsexed, Djishigotong, Yalung Basin, 13,000 feet, July; all in Szechwan.

Two females and one unsexed from Sungpan, northwest Szechwan (all poor specimens), taken in July, when compared with the above series appear to be not very different. The streaks on the throat and nape are sparser and the brown on the inner primaries is not quite so bright and pronounced in the northern specimens.

118. *FULVETTA INSUPERATA* Riley

Fulvetta insuperata RILEY, Proc. Biol. Soc. Washington, vol. 43, p. 123, 1930 (Ndamucho, 14,000 feet, Yunnan).

The type and only specimen was secured at Ndamucho, 14,000 feet, Yunnan, October.

This specimen agrees with no described species of the genus so far as ascertained. It was described as follows:

Similar to *Fulvetta ruficapilla sordidior*, but pileum deep brownish drab, instead of light mars brown; no whitish around the eye; inner primaries and outer secondaries edged externally basally with buckthorn brown instead of sudan brown; rump and the base of the rectrices a much lighter brown; throat more heavily streaked with dusky; bill wholly black, instead of the base being lighter; feet considerably heavier.

Description.—Pileum deep brownish drab, bordered on each side above the superciliary line and commencing just over the eye, by a black line extending on to the upper back; the superciliary, lores, ear-coverts, and cheeks, light drab; throat pale drab-gray with rather broad dusky streaks; chest and breast, light drab; belly a little lighter than the breast; flanks and under tail-coverts, buckthorn brown; back, hair-brown; lower back scapulars and rump,

⁴⁶ Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 25, 1923.

buckthorn brown; tail, dark mouse gray, the outer feathers fringed externally basally with the color of the rump; wing-coverts deep mouse gray edged outwardly with the color of the rump; primaries and secondaries deep mouse gray, the four outer primaries edged outwardly with light olive-gray, the inner primaries, commencing with the seventh, and the secondaries edged externally basally with buckthorn brown; under wing-coverts and inner margins of the remiges basally, white; bill (in the skin) dull black; feet, blackish brown. Wing, 61; tail, 58; culmen, 9.5; tarsus, 24; middle-toe, 13 mm.

Remarks.—The U. S. National Museum contains eight specimens of *F. r. sordidior* and all of the specimens, that are unstained around the head, have a narrow white line above the eye and below it, but not meeting behind. *Fulvetta insperata* does not show a trace of an eye-ring. In *F. r. sordidior* the black line bordering the pileum on each side extends further forwards. Dr. Rock's men took both *F. r. sordidior* and the present bird at the same locality, otherwise I should have considered them only forms of the same species. This can hardly be *Fulvetta manipurensis* Grant from Manipur, though judging from the inadequate description of the original describer and that of Stuart Baker (*Fauna Br. Ind.*, Birds, ed. 2, vol. I, 1922, p. 292) it is apparently closely related. The latter compares it with *F. vinipecta*, however, while *F. insperata* resembles *F. ruficapilla* more closely.

119. FULVETTA RUFICAPILLA SORDIDIOR (Rippon)

Proparus sordidior RIPPON, Bull. Brit. Orn. Club, vol. 13, p. 60, 1903 (Talifu, Yunnan).

One male and one unsexed, northwest Yunnan (Yulo, 7,000 feet, August; and Ndamucho, 14,000 feet, October); two males and one female, southwest Szechwan (Muli Mountains, 9,800–10,000 feet, June; Mount Mitzuga, Muli, 10,000 feet, June; and forests of Noön east of Muli, 10,500 feet, August).

A poor female specimen of *F. r. ruficapilla* from Wenchwan, Szechwan, taken in August is very close to the above female from Noön. The pileum in *ruficapilla* is brighter, more russet, and the cheeks are more strongly washed with a deeper and more vinaceous-drab.

120. FULVETTA VINIPECTA BIETI (Oustalet)

Alcippe (Proparus) bieti OUSTALET, Ann. Sci. Nat., ser. 7, vol. 12, p. 284, pl. 9, fig. 2, 1892 (Tatsienlou.)

Three males, seven females, and six unsexed specimens from Yunnan (Likiang Mountains, 10,000 feet, January–February and September; Luddü Mountains, 12,000–13,000 feet, August); three males and six females from southwest Szechwan (Muli, 10,500 feet, December; Mount Gibboh, 13,000 feet, Muli, May; Mount Mitzuga, 13,500 feet, Muli, June; Watogomba forests, 12,500 feet, Yalung watershed, July; forests of Bonti, east of Waerhdje, 12,500 feet, July; Zimi Valley, west of Waerhdje, 15,000 feet, August; Mundon, 13,000 feet, May).

In the report of a previous collection by Doctor Rock,⁴⁷ certain differences between this race and *Fulvetta v. vinipecta* were given.

⁴⁷ Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 28, 1926.

Though in the main these remarks are correct and could even be expanded, there is one mistake; the crissum in *F. v. bieti* is deep olive-buff and in some specimens there is a slight wash of buffy on the belly, but in comparison with *Fulvetta v. vinipecta* this is hardly noticeable. In *F. v. bieti* the white superciliary extends forward to the bill, while in *F. v. vinipecta*, it does not extend forward of the eye. It would seem as if *Fulvetta bieti* should be given specific rank, except I have not examined specimens of all the races, but from descriptions they seem to be quite distinct.

121. *LIOPARUS SWINHOOI FORRESTI* (Rothschild)

Fulvetta chrysotis forresti ROTHSCILD, Bull. Brit. Orn. Club, vol. 46, p. 64, 1926 (Shweli-Salween Divide, Yunnan).

Five males and one female, Ndamucho, 14,000 feet, October.

The above series has been compared with a poor specimen (male) from Wenchwan and an unsexed specimen from Mount Omei, Szechwan, of *Lioparus s. swinhoii*. The Wenchwan bird is so poor that it may be disregarded, but it is much lighter in all its markings than the Mount Omei specimen and may represent a more northern race. The Yunnan series when compared with the Mount Omei specimen is not strikingly different. The Mount Omei bird is darker in all its markings and the throat is dull black; the throat in *forresti* is slaty gray with silvery-gray tips to the feathers. The auricular region in *forresti* is grayish; in the Mount Omei specimen of *swinhoii* it is silvery white. The chief difference between the two races lies apparently in the different color of the throat and auricular region.

In one specimen of *forresti* the whole throat is yellow like the breast instead of gray. It is marked as a male, but I think this is a mistake and that it is really a female. The specimen marked as a female has the lower throat tinged with yellow, but this color does not come as far forward as in the former. The works consulted, however, do not mention any difference in the sexes and the above differences may be due to age.

The differences between *L. chrysotis* and *L. swinhoii* are sufficiently great, in my opinion, to warrant keeping them apart as species.

122. *ALCIPPORNIS NIPALENSIS YUNNANENSIS* (Harrington)

Alcippe fratercula yunnanensis HARRINGTON, Bull. Brit. Orn. Club, vol. 33, p. 63, 1913 (Gyi-dzin-shan, east of Talifu, Yunnan).

One male and one female, Muli forests, 10,000 feet, May; one male, Muli Mountains, 10,000 feet, southwest Szechwan, June; one male, Shintsang, 11,000 feet, Yunnan, September.

The three specimens from southwest Szechwan when compared with two males and one female from northwest Yunnan are considerably paler on the back and lowerparts, especially the latter. This may be due to fading, as the three Szechwan birds were taken in May while the Yunnan specimens were taken in September, November, and March.

123. *MOUPINIA POECILOTIS SORDIDIOR* Rothschild

Moupinia poecilotis sordidior ROTHSCHILD, Nov. Zool., vol. 28, p. 36, 1921 (Likiang Range, Yunnan).

Two males and one female from Yunnan (Likiang Mountains, January–February, September, and October); six males, one female, and two unsexed from southwest Szechwan (Kulu Mountains, 11,000 feet, December; Muli Mountains, 10,000–11,000 feet, June; Zimi Valley, 15,000 feet, west of Waerhdje, August; Noön, 10,500 feet, east of Muli, August; Dshizhi, 13,500 feet, April).

This series is barely separable from four skins from western Szechwan (Sungpan, Wenchwan, Tashi-ang-lin Pass, Mount Omei). The superciliaries in *M. p. poecilotis* are whitish, not so grayish as *M. p. sordidior*; the cheeks more tinged with buffy. The throats in *M. p. poecilotis* are not a clearer white as formerly stated⁴⁸; this was a slip of the pen.

124. *SCHOENIPARUS DUBIUS GENESTIERI* (Oustalet)

Aloippe genestieri OUSTALET, Bull. Mus. d'Hist. Nat. Paris, vol. 3, p. 210, 1897 (Tsekou, Yunnan).

Three females, northwest Yunnan (Ndamucho, 14,000 feet, October; Yungning Plain, 9,500 feet, December); four males and one female, southwest Szechwan (Noön Valley, 10,500 feet, east of Muli, August).

In reporting upon an earlier collection⁴⁹ made by Doctor Rock in Yunnan, I recognized *Schoeniparus intermedius* as a very distinct race of *dubius*. Since then Lord Rothschild says that he and Doctor Hartert have reached the firm opinion that *intermedius* is nothing more than an immature stage of plumage of *genestieri*.⁵⁰

This has caused me to reexamine my series. All the specimens I then called *S. g. genestieri* are apparently birds of the year taken in June and August with a rusty cast above, especially on the wings and tail. I have never seen a very young bird of this species, but the young of *Schoeniparus brunneus olivaceus* is more rufous than the adult and it is logical to suppose it would be also in *genestieri*.

⁴⁸ Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 29, 1926.

⁴⁹ Idem.

⁵⁰ Nov. Zool., vol. 33, p. 270, 1926.

125. *LIOPTILA DESGODINSI* (David and Oustalet)

Sibia desgodinsi DAVID and OUSTALET, Bull. Soc. Philom. Paris, ser. 7, vol. 1, p. 139, 1877 (Yerkalo, southwest Szechwan).

Seven males, four females, and one unsexed, northwest Yunnan (Likiang Mountains, September; Muli-Yungning border, 11,000 feet, August; Gawua Mountains, 11,500 feet, Yungning, April; Luddü Mountains, 12,000–13,000 feet, August; Ndamucho, 14,000 feet, October); four males and four females, southwest Szechwan (forests of Baude-Shaya, 12,000 feet, east of Muli, July; forests of Noön, 11,000 feet, east of Muli, August; between Tsoso and Kulu, 10,500 feet, December).

126. *SIVA CYANOUREPTERA WINGATEI* Grant

Siva wingatei GRANT, Bull. Brit. Orn. Club, vol. 10, p. 38, 1900 (Yunnan City).

Two males, five females, and one unsexed, northwest Yunnan (Shintsang, 11,000 feet, September; and Fuchuanshan, 10,000–12,000 feet, September).

All the above specimens, except two, have a primrose-yellow wash to the breast and belly; quite decided in two or three cases. I have examined four fall taken birds from southern Szechwan in similar plumage. This color seems to fade out even before winter, as several specimens taken at that season are without it.

127. *SIVA STRIGULA YUNNANENSIS* Rothschild

Siva strigula yunnanensis ROTHSCHILD, Nov. Zool., vol. 28, p. 40, 1921 (Likiang Mountains, Yunnan).

One male, Luddü Mountains, 12,000–13,000 feet, August; and two males and one unsexed, Ndamucho, 14,000 feet, October, both localities in northwest Yunnan.

The three October specimens are in deep fresh plumage; quite different from the faded summer dress.

128. *MINLA IGNOTINCTA JERDONI* Verreaux

Minla jerdoni VERREAUX, Nouv. Arch. Mus. Paris, vol. 6, Bull., p. 38, 1870 (Chengtü, Szechwan).

One female, upper slopes of the Fuchuanshan, 10,000–12,000 feet, Yunnan, September.

In 1926 Lord Rothschild⁵¹ gave a key to the races known to him at that time, but the allocation of *jerdoni* to the section, "breast white or cream," certainly does not agree with the series in the United States National Museum, which is quite an extensive one. All the males of *jerdoni* have the lowerparts mustard yellow, even the throat being suffused with this color, but in many specimens the throat is much lighter or even white. *Minla ignotincta mariae* LaTouche

⁵¹ Nov. Zool., vol. 33, p. 275, 1928.

from southeast Yunnan is not a well-marked race; the back is browner and the breast a much lighter yellow than *M. i. jerdoni*. I should amend the key to read as follows:

- | | |
|--------------------------------|------------|
| 1. Back olive | 2 |
| Back Mars brown | ignotincta |
| 2. Breast mustard yellow | jerdoni |
| Breast primrose yellow | mariae |

Stresemann⁵² has recently named a race, *Minla ignotincta sini*, from the Yaoschan, Kwangsi, but I have seen no specimens of it.

129. *LIOTHRUX LUTEUS YUNNANENSIS* Rothschild

Liothrix luteus yunnanensis ROTHSCHILD, Nov. Zool., vol. 28, p. 42, 1921 (Shweli-Salwin Divide, Yunnan).

Three females, Ndamucho, 14,000 feet, Yunnan, October.

When a report was published⁵³ on Doctor Rock's first collection from Yunnan and Szechwan, the United States National Museum possessed an inadequate series of *Liothrix luteus luteus*, and my remarks based upon a comparison of the present race with it are misleading and erroneous. Since then a large series of *L. l. luteus* has been acquired from Szechwan, and the differences between it and *L. l. yunnanensis* are not so pronounced as appeared at first. Instead of being more highly colored, *L. l. yunnanensis* is actually paler below, but above there is little difference. *L. l. yunnanensis* is a larger bird, but the chief difference between it and *L. l. luteus* lies in the color of the outer webs of the base of the outer primaries; in the latter they are much deeper, not the reverse as formerly stated.

In *L. l. yunnanensis* the yellow outer margin to the inner primaries is interrupted near the middle, while in *L. l. luteus* no such interruption occurs. *L. l. yunnanensis* is a well-marked race.

130. *PTERUTHIUS AERALATUS RICKETTI* Grant

Pteruthius ricketti GRANT, Bull. Brit. Orn. Club, vol. 14, p. 92, 1904 (south China).

Two unsexed specimens from the Yungning-Muli border, 11,000 feet, August; one female, upper slopes of the Fuchuanshan, 14,000 feet, Yunnan, October.

131. *PTERUTHIUS XANTHOCHLORIS PALLIDUS* (David)

Allotrius xanthochloris var. *pallidus* DAVID, Nouv. Arch. Mus. Paris, vol. 7, p. 14, 1871 (Frontiers of Kookonor).

One female, Shintsang, 11,000 feet, northwest Yunnan, September.

⁵² Journ. f. Orn., vol. 77, p. 333, 1929.

⁵³ Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 32, 1926.

132. *YUHINA NIGRIMENTUM INTERMEDIA* Rothschild

Yuhina nigrimentum intermedia ROTHSCHILD, Bull. Brit. Orn. Club, vol. 43, p. 11, 1922 (Mekong-Salwin Divide, Yunnan).

Two males and one female, northwest Yunnan (Fuchuanshan, 9,800 feet, September; and Shintsang, 11,000 feet, September).

This series of three specimens is paler below, with whiter throats, than the same number of *Y. n. nigrimentum* in the National Museum from Sikkim and Darjeeling. The National Museum has a series of seven specimens from Tseo Jia Keo, in Szechwan south of Suifu and just north of the Yunnan border, taken in March. The latter are paler than the three Yunnan specimens; more so, in fact, than the latter are from the Indian race. I have named this race *Yuhina nigrimentum quarta*.⁵⁴

133. *YUHINA GULARIS GRISEOTINCTA* Rothschild

Yuhina gularis griseotincta ROTHSCHILD, Nov. Zool., vol. 28, p. 42, 1921 (Shweli-Salwin Divide, Yunnan).

One female, Luddü Mountains, 12,000–13,000 feet, Yunnan, August.

This specimen is quite pale below, probably because of fading. Recently Doctor Graham sent in three males taken on Mount Omei, Szechwan; these were much paler than *griseotincta* and were named *Yuhina gularis omeiensis*.⁵⁵ A race has also been found in Tonkin and named *Yuhina gularis sordidior* Kinnear.⁵⁶ *Yuhina gularis yangpiensis* was originally named from Yangpi on the Talifu Road, western Yunnan, and has never been taken there since, but has been taken on Mount Victoria, Burma, in some numbers. I have never seen a specimen, but Rothschild⁵⁷ says it is darker on the back and more strongly washed below with rufous than *Yuhina gularis gularis*.

134. *YUHINA OCCIPITALIS OBSCURIOR* Rothschild

Yuhina occipitalis obscurior ROTHSCHILD, Nov. Zool., vol. 28, p. 42, 1921 (Likiang, Yunnan).

One male and six females, northwest Yunnan (forests west of Yungning, 13,000 feet, May; Luddü Mountains, 12,000–13,000 feet, August).

This series is very much worn and faded below.

135. *YUHINA DIADEMATA DIADEMATA* Verreaux

Yuhina diademata VERREAUX, Arch. Mus. Paris, vol. 5, Bull., p. 35, 1869 (Mupin).

⁵⁴ Proc. Biol. Soc. Washington, vol. 43, p. 134, 1930.

⁵⁵ Idem.

⁵⁶ Bull. Brit. Orn. Club, vol. 45, p. 74, 1925.

⁵⁷ Nov. Zool., vol. 33, p. 276, 1926.

A good series from northwest Yunnan (Likiang Mountains, January–February, September, and October; summit of Yuli watershed, 13,000 feet, May; Ndamucho, 14,000 feet, October); two males and three females from Szechwan (Muli Mountains, 10,000 feet, June; Noön, east of Muli, 10,500 feet, August; Yanwekong Valley, 10,000–12,000 feet, May).

This series compared with a small series taken at the same time of the year from farther north in Szechwan is slightly darker on an average, but there are individual specimens that seem to be identical. It seems to me that the differences are too slight to recognize by name. If *Yuhina ampelina* Rippon is worthy of recognition at all, it will have to be restricted to western Yunnan and the Burma border. Rothschild⁵³ says that some fresh unworn specimens of *ampelina* are almost sooty black, but he seems to be somewhat in doubt as to the Yunnan bird from farther east. None of the above series is as dark as one would be led to expect from his remarks. No specimens are available for comparison from the type locality of *ampelina*.

Family PYCNONOTIDAE, Bulbuls

136. MICROSCELIS LEUCOCEPHALUS (Gmelin)

Turdus leucocephalus GMELIN, Systema naturae, vol. 1, pt. 2, p. 829, 1789 (China).

Six males and five females, northwest Yunnan (forests west of Yungning, 12,000 feet, May; Luddü Mountains, 12,000–13,000 feet, August; Yulo, 7,000 feet, August; Shintsang, 11,000 feet, September); three males and six females, southwest Szechwan (Litang River Valley, Muli, 10,000 feet, May; mountains of Muli, 10,000 feet, June; Muli Valley, 10,000 feet, June; forests of Noön, east of Muli, 10,500 feet, August).

All the phases of plumage, except the entirely black, are represented in the above series. Three of the specimens are dark neutral gray above, the pileum shining black, the lowerparts a much lighter gray than the back, the middle of the breast and the belly with white markings on the feathers forming a line; two of the specimens are getting a few white feathers on the forehead. All three are evidently immature, assuming the first adult plumage; the two with white on the foreheads taken in May, the other in September. Three immatures with considerable of the brownish juvenal feathers still remaining were taken in August. All three are molting into a black plumage above; one into a black plumage below, but another into a gray one below. All three, however, have the feathers of the center

⁵³ Nov. Zool., vol. 32, p. 277, 1926.

of the breast and belly with white markings, forming a line down the center.

I have nothing to add to my former remarks.⁵⁰ I would suggest, however, that the black-breasted white-headed and gray-breasted white-headed birds might belong to different sexes. The sexing of the specimens available is too unreliable to prove this, however.

137. *SPIZIXOS CANIFRONS* Blyth

Spizixos canifrons BLYTH, Journ. Asiat. Soc. Bengal, vol. 14, p. 571, 1845 (Cherra Punji).

Two males and two females, northwest Yunnan (Gauwua, 11,000 feet, January; Luddü Mountains, 12,000–13,000 feet, August; Likiang Mountains, September); four males, one female, and one unsexed, southwest Szechwan (Muli Mountains, 10,000 feet, April and June; Noön, east of Muli, August).

138. *PYCNONOTUS XANTHORHOS* Anderson

Pycnonotus xanthorhous ANDERSON, Proc. Asiat. Soc. Bengal, p. 265, 1869 (Manwyne, Yunnan).

Three males and four females, northwest Yunnan (Likiang Mountains, 10,000 feet, January–February; mountains of Yungning, 12,000–13,000 feet, November–December; Weihsi, 8,000–9,000 feet, September; Ndamucho, 14,000 feet, October); one male, southwest Szechwan (Noön, 10,500 feet, east of Muli, August).

Family CINCLIDAE, Dippers

139. *CINCLUS PALLASII SOULIETI* Oustalet

Cinclus pallasii var. *souletii* OUSTALET, Ann. Soc. Nat., Zool., ser. 7, vol. 12, p. 299, 1891 (1892) (Tatsienlou and Mupin).

One female, Noön Valley, 11,000 feet, east of Muli, southwest Szechwan, August.

140. *CINCLUS CINCLUS BEICKI* Meise

Cinclus cinclus beicki MEISE, Orn. Monatsb., vol. 36, p. 138, 1928 (Langs-tang-scul-schlucht, north Kansu).

Two males, southwest Szechwan (Djago, 10,400 feet, December, and Yetsi Valley, 12,000 feet, April).

These two specimens are grayer on the back without the brownish wash, darker on the pileum and hind neck and much darker on the breast than *Cinclus cinclus cashmeriensis*. In these two specimens each feather on the back is outlined with a black border. Though this occurs also in *cashmeriensis*, it is not so pronounced. A male

⁵⁰ Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 21, 1926.

from the Likiang Mountains, Yunnan, and a female from Sungpan, Szechwan, are somewhat lighter than the two specimens listed above, especially the male from Yunnan, which has the pileum and hind neck much lighter, more like Kashmir specimens, but it is quite worn. On geographic grounds these birds should belong to *Cinclus cinclus szetschwanensis* Meise,⁸⁰ but Mr. Bangs informs me that this is a synonym of *beicki*. I have examined no specimens from Kansu.

Family TROGLODYTIDAE, Wrens

141. SPELAEORNIS ROCKI Riley

Spelaeornis rocki RILEY, Proc. Biol. Soc. Washington, vol. 42, p. 214, 1929 (mountains of Hofuping, Mekong Valley, Yunnan).

One female, west of Yungning, 13,000 feet, May, and one male, Ndamucho, 14,000 feet, northwest Yunnan, October.

During a previous expedition to Yunnan, Doctor Rock collected the type. This was originally assigned to *Spelaeornis souliei* as possibly representing a young plumage.⁸¹ Later Doctor Rock sent in the female from west of Yungning, which, while differing from the type in minor details, evidently belongs to the same species. As these two specimens differed materially from the figure of the type of *Spelaeornis souliei* given by Hartert,⁸² and the supposition that they were young plumages of that species could no longer be maintained, it was described as new as follows:

Pileum argus brown, each feather rather broadly tipped with black and with a rather large sub-apical white spot; upper-parts sudan brown, each feather tipped narrowly with black and with a small triangular buffy-white spot; cheeks and sides of neck a little lighter than the back, with buffy shaft streaks, the feathers with narrow black tips; the feathers around the eye white posteriorly; throat and jugulum white; breast, sides and flanks ochraceous-tawny, the feathers of the breast and abdomen with rather broad white shaft-streaks and rather narrow black tips; the flanks with a few narrow white shaft-streaks, the under tail-coverts a little darker than the flanks, each feather with a sub-apical white bar and black tip; wing-coverts deep mouse gray with a brownish wash with a few white shaft-streaks and barred with black; flight feathers snuff brown rather broadly barred with black; tail snuff brown with narrow, irregular black bars; the upper mandible fuscous-black; the lower mandible chamois (in the skin). Wing, 48; tail, 50; culmen, 10; tarsus, 20; middle-toe, 13 mm. The specimen from west of Yungning, 13,000 feet, Yunnan, May, 1923 (U. S. Nat. Mus. No. 312284), differs from the type in having the forehead more profusely spotted with white; the white sub-apical spots and black tips to the feathers of the pileum smaller; the basal color of the crown and occiput of the same color as the back; below, the white of the jugulum extends down the center of the breast, the black apical spots are obsolescent, and the white shaft-streaks on the flanks have almost disappeared. It measures: Wing, 47.5; tail, 50.5; culmen, 10.5; tarsus, 19.5; middle-toe, 12 mm.

⁸⁰ Orn. Monatsb., vol. 36, p. 139, 1928.

⁸¹ Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 33, 1926.

⁸² Nov. Zool., vol. 17, pl. 7, fig. 1, 1910.

On Doctor Rock's return from his second Yunnan expedition for the National Geographic Society, he brought back the third specimen of this species received by the United States National Museum, namely, the male from Ndamucho. Above this specimen is similar to the Yungning female mentioned before, but below the white does not extend so far down the breast. It measures: Wing, 49; tail, 55; culmen, 11; tarsus, 19.5; middle toe, 13.5 mm.

Comparing *Spelaornis rocki* with Hartert's figure of the type of *Spelaornis souliei*, the former is lighter above with the black apical spots more conspicuous; the flanks are lighter and the black apical spots smaller; and the white of the throat extends down on the jugulum and breast. It seems strange that this species should occur so near the type locality of *Spelaornis souliei*.

Doctor Rock informs me that he found this species to be rather common in more or less open country where it frequented low scrubby growth. On being approached, it came toward the collector until it was too close to shoot. Out of numerous birds shot, he was able to save only the two listed above.

142. *NANNUS TROGLODYTES TALIFUENSIS* (Sharpe)

Anorthura talifuensis SHARPE, Bull. Brit. Orn. Club, vol. 13, p. 11, 1902 (Gyidzin-shan, Yunnan).

Three males, two females, and one unsexed, northwest Yunnan (Likiang Mountains, 10,000–12,500 feet, January–February, March); two males and eight females, southwest Szechwan (back of Mount Mitzuga, 12,000 feet, Muli, June; Mount Mitzuga, 14,500 feet, June; Zimi Valley, 14,900 feet, west of Waerhdje, August; Raronki, 12,400 feet, Shouchu River Basin, August; Djago, 11,200–12,000 feet, April).

The present race and *Nannus troglodytes szetschuanus* from southern Szechwan, at least, are certainly very close, if not identical. It may be necessary to unite them when better material is available for study. A breeding bird from Tatsienlu almost, if not quite, matches breeding birds from the Likiang Mountains and Muli, in color and size. My series from northern and central Szechwan is poor, either taken in winter or immature, with one exception.

Family PRUNELLIDAE, Accentors

143. *LAISCOPUS COLLARIS RIPPONI* (Hartert)

Prunella collaris ripponi HARTERT, Die Vögel der paläarktischen Fauna, vol. 1, Heft 6, p. 766, 1910 (Gyidzin-shan, Yunnan).

One male and one female, northwest Yunnan (Likiang Mountains, 14,500–15,000 feet, January); 13 males, 11 females, and 5 im-

mature specimens, southwest Szechwan (Mount Konka, 16,500–17,000 feet, June and August; crags of Dzampe-Shoren, east of Waerhdje, 15,600 feet, July; Mount Gibboh, 13,000–14,000 feet, Muli, April; Barongomba, 11,000–12,000 feet, no date; Yulonghsi Valley, 13,000–16,000 feet, May; Chengtze, 14,500–15,900 feet, May).

Two females in worn plumage from near Tatsienlu, July, received from the Rev. David C. Graham, agree with the above series in wing measurement and without much doubt belong to the same form.

144. *PRUNELLA IMMACULATA* (Hodgson)

Accentor immaculatus HODGSON, Proc. Zool. Soc. London, 1845, p. 34 (Nepal).

One female and one unsexed, southwest Szechwan (Brüolo-kong Valley, 13,000–15,900 feet, May; and Chiu-lung-hsien, halfway between Muli and Tatsienlu, May).

145. *PRUNELLA RUBECULOIDES FUSCA* MAYR

Prunella rubeculoides fusca MAYR, Orn. Monatsb., vol. 35, p. 148, 1927 (Bamutang, 2 days' trip southwest of Bantang, Szechwan).

One male and one female, southwest Szechwan (Yulonghsi, 13,000–16,000 feet, May; and Yulinggong, 10 miles south of Tatsienlu, 11,000 feet, May).

These two specimens agree fairly well with a male from Choni, Kansu, and a female from the Kokonor near Radja. Both the Kansu and Szechwan specimens differ from three males and a female from Kashmir in being darker above, especially on the head; the throats are darker; and the breast is a deeper tawny. The Kashmir birds also have slightly longer wings. Bangs and Peters⁶⁸ intimate that the Szechwan bird is somewhat darker than that from northern Kansu and northeastern Tibet, but the two specimens listed above do not seem to uphold this view. If *Prunella rubeculoides beicki* Mayr is to be recognized at all, it seems to me it must be for a form more to the northwest in Kansu and probably Mongolia.

146. *PRUNELLA STROPHIATA MULTISTRIATA* (David)

Accentor multistriatus DAVID, Ann. Mag. Nat. Hist., ser. 4, vol. 7, p. 256, 1871 (Mupin).

Five males and one unsexed, northwest Yunnan (Likiang Mountains, 10,000–11,000 feet, January–February; Ndamucho, 14,000 feet, October); a good series of adults and young, southwest Szechwan (Mount Mitzuga, 13,500–14,500 feet, June; Mount Konka, 15,000–15,700 feet, June and August; forests of Bonti, east of Waerhdje, 12,500, July; forests of Raronki, north of Muli, 12,400 feet, August;

⁶⁸ Bull. Mus. Comp. Zool., vol. 38, no. 7, p. 355, 1928.

Ronopien region, Shouchu River Basin, 15,000 feet, August; Yulonghsi Valley, 13,000–16,000 feet, May; Minya Mountains, 14,500 feet, no date).

Five males from Sungpan are less heavily streaked on the breast, but the difference is slight and may be more apparent than real. The Sungpan skins are not in very good condition.

Family TURDIDAE, Thrushes

147. *Heteroxenicus cruralis formaster* Thayer and Bangs

Heteroxenicus cruralis formaster THAYER and BANGS, Mem. Mus. Comp. Zool., vol. 40, no. 4, p. 169, 1912 (Mount Washan, Szechwan).

One adult female, Likiang Mountains, Yunnan, October.

When I published a paper on Doctor Rock's first expedition to Yunnan for the National Geographic Society a series of this form was doubtfully identified as *Heteroxenicus sinensis*.⁶⁴ At that time there was no specimen of the latter in the United States National Museum, and I relied upon descriptions for identification. Since then I have seen the series in the Museum of Comparative Zoölogy, and the National Museum has acquired by exchange a pair of *H. sinensis* from the type locality. The Likiang specimens are entirely different, much larger and darker; about as different as two species well could be. The male of *sinensis* is dark plumbeous above; slate gray below; the throat, middle of the breast, belly, and under tail coverts tinged with white; lores slate color; superciliary white. The male of *formaster* is dusky slate blue above; the throat either dusky slate blue or bluish black; the breast dusky slate blue; the middle of the abdomen barely tinged with deep neutral gray; lores black; superciliary white. The females of the two species are quite distinct also. The female of *formaster* is rustier on the forehead and deeper colored above; the abdomen grayish; and there are many other differences, but size alone is sufficient.

The bird listed at the head of this account is not quite the same as the previous series from Yunnan. It is more olivaceous above and below and not so rusty on the forehead. It is a fall bird, while the previous series were taken in summer, and the difference may be seasonal.

The type of *Heteroxenicus cruralis laurentei* LaTouche⁶⁵ is now in the Museum of Comparative Zoölogy and has been kindly loaned to me by the authorities of that institution for comparison. Without much doubt it is the same as the birds I formerly identified as *H. sinensis*, and which is also the *H. sinensis* of Stuart Baker.⁶⁶ LaTouche overlooked Thayer and Bangs's description of *formaster*, and evidently Stuart Baker did also. It is very doubtful to my mind if

⁶⁴ Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 30, 1926.

⁶⁵ Bull. Brit. Orn. Club, vol. 42, p. 29, 1921.

⁶⁶ Fauna of British India, Birds, ed. 2, vol. 2, p. 1924.

Heterowenicus sinensis ranges as far to the westward as Yunnan, but if it does it belongs to a different species and has nothing to do with the *cruralis* group.

The single male of *H. sinensis* measures: Wing, 62.5; tail, 49; culmen, 12; tarsus, 28 mm. Five males of *H. c. formaster* measure: Wing, 68.5-73 (71.3); tail, 49-57 (51.9); culmen, 13-14 (13.5); tarsus, 31-33.5 (32 mm.). The type of *H. c. laurentei* measures: Wing, 71; tail, 50; culmen, 14.5; tarsus, 33 mm.

The female of *H. sinensis* measures: Wing, 62.5; tail, 49; culmen, 12; tarsus, 26.5 mm. Four females of *H. c. formaster* measure: Wing, 67-70 (68.8); tail, 44-47 (45); culmen, 12-13.5 (12.9); tarsus, 28.5-31 (29.9 mm.).

Thayer and Bangs in the original description of *H. c. formaster*, cited above, give the measurements of the male as: Wing, 73; tail, 47; culmen, 14; tarsus, 34 mm.; and of the female as: Wing, 70; tail, 45; culmen, 13; tarsus, 32.5 mm.

148. MYOPHONUS EUGENEI Hume

Myiophonus eugenei HUME, Stray Feathers, vol. 1, p. 475, 1873 (Pegu).

Five males and one female, northwest Yunnan (Likiang Mountains, October; forests of Gowa, 10,000 feet, May; Fuchuan-shan, 10,000-12,000 feet, September; Ndamucho, 11,000 feet, October); one male and three females, southwest Szechwan (Shouchu Valley, near Dzeru, 11,300 feet, August; Mutirong, 7,000-7,800 feet, Muli, April; Chiu-lung-hsien, halfway between Muli and Tatsienlu, May; Tatsienlu, 9,500-10,000 feet, May).

Lord Rothschild⁶⁷ now regards this as a species, as he says that in certain areas *temminckii* and *eugenei* occur together. In the quite extensive series of the latter in the United States National Museum from western China, there are no intermediates between it and *temminckii*. *Myiophonus c. caeruleus* and its western form *immansuetus* are so distinct from *eugenei* and *temminckii* that hybrids between them must be very rare, though Lord Rothschild says there are hybrids between *temminckii* and *caeruleus*. This must be exceptional, however, because I am not aware that the ranges of the two latter meet at any point. Hybrids between *eugenei* and *temminckii* are not so surprising, as their ranges must meet at a number of points.

149. GRANDALA COELICOLOR FLORENTES Bangs

Grandala coelicolor florentes BANGS, Proc. New England Zool. Club, vol. 9, p. 78, 1926 (Tachienlu, Szechwan).

Thirteen adult males, two immature males, and nine adult females, southwest Szechwan (Mount Konka, 16,500-17,000 feet, June and

⁶⁷ Nov. Zool., vol. 33, p. 256, 1926.

August; Yulonghsi Valley, 13,000–16,000 feet, May; Brüolo-kong Valley, 13,000–15,900 feet, May; Chengtze, 14,500–15,900 feet, May; Chüchulongba Valley, 13,000–14,000 feet, no date; valley of Jesi-longba, 14,500–16,000 feet).

This series of males is even a lighter, brighter blue than in the two males previously reported upon from Yunnan.⁸⁸ Indian males are a darker, dingier blue. The female of *florentes* is darker than the same sex of *coelicolor*; the shaft spots of the lowerparts and on the head, neck, and upper back are narrower and more of a pale olive-buff in *florentes*, rather than the pinkish buff in *coelicolor*. It is rather astonishing to find the female when adult retaining the plumage of the young.

The two immature males are exactly like the adult female, except they are assuming the blue of the adult on the belly, lower back, and lesser wing coverts; they have already acquired the black tail and all the primaries are new or in growth, except the spurious and the second one; the secondaries are new internally, old externally; the greater wing coverts and primary coverts have been renewed; the middle coverts and the alula have not been renewed yet. These two young were taken in August.

150. *LARVIVORA BRUNNEA BRUNNEA* Hodgson (?)

Larvivora brunnea HODGSON, Journ. Asiat. Soc. Bengal, vol. 6, p. 102, 1837 (Nepal).

One female, Likiang Mountains, Yunnan, October.

It is with a good deal of hesitation that I assign the above specimen to this form. It does not agree with two females from the same locality previously listed as of this race.⁸⁹

It is darker above and below, but this may be due to the different season of the year at which it was secured. The under tail coverts are ochraceous-buff instead of white. It has a smaller bill, culmen 12 mm., instead of 13 mm. It is extremely doubtful if it belongs to *brunnea* at all, but it apparently belongs to this genus and there are no other species to which to assign it. It would not be advisable to name it on the material at hand.

151. *IANTHIA RUFILATA PRACTICA* Bangs and Phillips

Ianthia practica BANGS and PHILLIPS, Bull. Mus. Comp. Zool., vol. 58, p. 292, 1914 (Loukouchai, Yunnan).

Two males and seven females, northwest Yunnan (Likiang Mountains, October and January–February; Mbayiwua, 10,000 feet, Yangtze loop, April; Gou-khü-ko, 13,000 feet, Yangtze loop, April;

⁸⁸ Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 35, 1926.

⁸⁹ Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 39, 1926.

Ndamucho, 14,000 feet, October); two males, eight females, and two spotted young, southwest Szechwan (Mount Konka, 14,500 feet, June; Zimi Valley, 15,000 feet, west of Waerhdje, August; forests of Bonti, 12,500 feet, July; Dshizhi, 13,500 feet, April; Aloching, 12,500-13,500 feet, Muli, April; Mutirong, 7,000-7,800 feet, Yalung Gorge, Muli, April).

The males seem to exhibit two color phases. One a cyanine blue above; the other marine blue. The former with the superciliary, rump, and lesser wing coverts very dark; the latter with these areas much lighter. Both styles of coloration were taken at Mbayiwua.

152. *IANTHIA INDICA YUNNANENSIS* (Rothschild)

Tarsiger indicus yunnanensis ROTHSCILD, Bull. Brit. Orn. Club, vol. 43, p. 10, 1922 (Likiang Range, Yunnan).

One male and one female, Ndamucho, 14,000 feet, northwest Yunnan, October; one male, valley above Djishi, 12,000 feet, southwest Szechwan, July.

Ianthia indica indica is not represented in the United States National Museum, but two adult males of the present race from farther north and east in Szechwan (Washan and south of Suifu) are considerably darker on the chest and outer margins of primaries than the two males listed above.

153. *HODGSONIUS PHOENICUROIDES PHOENICUROIDES* (Gray)

Bradypterus phoenicuroides GRAY, Catalogue of the specimens of Mammalia and Birds of Nepal and Thibet, presented by B. H. Hodgson to the British Museum, ed. 1, pp. 70, 153, 1846 (Nepal).

Two males and one female, northwest Yunnan (Likiang Mountains, October; and Luddü Mountains, 12,000-13,000 feet, August); four males and three females, southeast Szechwan (Yalung River Gorge below Reddo, 11,000 feet, July).

Two of the specimens listed above as females are much darker above and below than the two that are undoubted females. One of these birds is acquiring blue feathers on the forehead, lesser wing coverts, and sides of neck on the right side. In both specimens the white is restricted below to the belly, and the bills are black to base or nearly so. It would appear as if these dark-colored specimens were really young males. If this is so, then the young male must molt from the spotted plumage of the juvenal dress into a plumage resembling the female, but darker. Other specimens of immature males from Szechwan in the National Museum seem to confirm this. In comparing females from widely separated localities due care should be taken to see that the specimens are correctly sexed. The undoubted females have the lower mandible light col-

ored at the base, while in the immature male in the female plumage the lower mandible is black to the base. At least the color of the bill seems to change before the adult plumage begins to be assumed.

154. *NOTODELA LEUCURA LEUCURA* (Hodgson)

Muscisylvia leucura HODGSON, Proc. Zool. Soc. London, 1845, p. 27 (Nepal).

One male, Litang River Valley, 10,000 feet, Muli, southwest Szechwan, June.

Only one male from Arbre Broye, South Annam, and one male from Margherita, North Assam, are available for comparison. In the Annam male the blue tinge to the upperparts and on the belly is more pronounced; the white area at the base of the tail is of greater extent; the bill and tail are longer than in the male from Muli. The Annam specimen measures: Wing, 97; tail, 85; culmen, 17; tarsus, 28.5 mm. The Muli male measures: Wing, 97; tail, 75; culmen, 15.5; tarsus, 28 mm. The north Assam male when compared with the Muli male has the black underlying color of the body not so deep, but with a grayish tinge; the blue cast above is also lighter. The Assam male measures: Wing, 93; tail, 72; culmen, 15; tarsus, 27.5 mm.

155. *TARSIGER CHRYSÆUS VITELLINUS* Stresemann

Tarsiger chrysaëus vitellinus STRESEMANN, Journ. f. Orn., 1923, p. 365 (Washan, Szechwan).

One male, Likiang Mountains, Yunnan, October; two males and three females, Mount Konka, 14,500 feet, June; one female, Mount Mitzuga, Muli, 13,000 feet, June; two males and one female, Djishi, northeast of Muli, 13,000 feet, July; two males and one female, Zimi region, west of Waerhdje, 14,800 feet, August; the four latter in southwest Szechwan.

The only Indian specimen that I have examined has the head and mantle much deeper in color (near medal bronze) and the lower parts, especially the throat and chest, a deeper cadmium yellow than any before me from Yunnan or Szechwan.

156. *RHYACORNIS FULIGINOSA FULIGINOSA* (Vigors)

Phoenicura fuliginosa VIGORS, Proc. Zool. Soc. London, 1831, p. 35 (Himalaya).

Three adult males, one immature male, and four females, northwest Yunnan (Likiang Mountains, 10,500–11,000 feet, September; Funkou, 6,500 feet, Yangtze Gorge, May; Fuchuanshan, 10,000–12,000 feet, September; Luddü Mountains, 12,000–13,000 feet, August; Ndamucho, 11,000 feet, October); six adult males and two adult females, southwest Szechwan (forests of Baude-Shaya, 12,500 feet, northeast of Muli, July; forests of Bonti, east of Waerhdje, July;

Noön forest, 10,500 feet, east of Muli, August; Mutirong, 7,000–7,800 feet, Muli, April; Yanwekong, 10,700 feet, May; Tatsienlu, 9,500–10,000 feet, May).

157. *CHAIMARRHORNIS LEUCOCEPHALA* (Vigors)

Phoenicura leucocephala VIGORS, Proc. Zool. Soc. London, 1830, p. 35 (Himalayas).

One male, one female, and one unsexed, northwest Yunnan (Likiang Mountains, October and February; Chütien, 6,500 feet, October); two males and one unsexed, southwest Szechwan (Mount Konka Chanandodji, 15,800 feet, August; Noön stream, 10,500 feet, east of Muli, August; Tatsienlu, 9,500–10,000 feet, May).

158. *PHOENICURUS ERYTHROGASTER MAXIMUS* Kleinschmidt

Phoenicurus erythrogaster maximus KLEINSCHMIDT, Abh. Ber. Mus. Tierk. Völk. Dresden, vol. 16, no. 2, author's separate, p. 8, 1923 (Janeti, Rombatsa, and Chuwo, Tibet); idem, 1924, p. 42.

One adult female, Likiang Mountains, 10,000 feet, January–February.

This specimen is considerably darker above and below than two females from Kashmir of *Phoenicurus erythrogaster grandis*. The Likiang female measures: Wing, 103; tail, 75; culmen, 15 mm. The two females from Kashmir, measure: Wing, 95–102; tail, 71–73; culmen, 12–12.5 mm. The present race was founded upon size alone. It would appear to have a somewhat larger bill, and, if the color difference pointed out above holds, it is well worthy of recognition.

159. *PHOENICURUS AUROREUS* (Pallas)

Motacilla aureora PALLAS, Reise durch verschiedene Provinzen des russischen Reichs, vol. 3, p. 695, 1776 (Selenka, Lake Baical).

One male, forests of Lapo-laze, 10,000 feet, Yunnan, May; one young in the spotted plumage, forests of Noön, east of Muli, 10,500 feet, August; and one male, Yanwekong, 10,700 feet, May, southwest Szechwan.

Though I am not now recognizing *P. a. leucopterus*, I am not sure but that eventually it will have to be done. All the specimens examined by me from the mountains of Szechwan and Yunnan appear to be darker below and on the head than the majority of the birds taken farther north. There appears to be little or no difference in size. The majority of the adult specimens from the mountains are nonbreeding birds, and some of these differences may be due to the unworn condition of the plumage. Stuart Baker⁷⁰ is wrong when he states that the species breeds only from Lake Baical

⁷⁰ Fauna of British India, Birds, ed. 2, vol. 2, p. 72, 1924.

eastwards to Korea, Japan, and northeast China. It breeds throughout the mountains of western China to Yunnan at least. Besides the spotted young recorded above, the United States National Museum contains this plumage from the mountains of Szechwan (Wenchwan, near Washan, and Mount Omei) and Yunnan (Likiang Mountains). There is also a specimen in the spotted plumage from Changshowkai, Hunan; this bird, however, is much lighter colored and may belong to another race. The young taken near Washan had barely left the nest and could hardly have wandered far.

160. *PHOENICURUS SCHISTICEPS* (Gray)

Ruticilla schisticeps GRAY, Catalogue of the specimens of Mammalia and Birds of Nepal and Thibet, presented by B. H. Hodgson to the British Museum, ed. 1, pp. 69, 153, 1846 (Nepal).

Eight males and 18 females from northwest Yunnan (Likiang Mountains, 10,000 feet, January–February; mountains of Yungning, 12,000–13,000 feet, November–December; Gou-khü-ko, Yangtze loop, 13,000 feet, April); three males and two females from southwest Szechwan (Muli Mountains, 10,000 feet, May; Mount Mitzuga, 13,000 feet, June; mountains of Kulu, 11,000–13,000 feet, December and April; Djago, 10,400 feet, December).

A series of seven males from Sungpan are as large as those from farther south. The wings of the Sungpan series of males measure: 83, 86.5, 81.5, 86, 84.5, 83, and 85 mm. The wings of the males from the Likiang Mountains measure: 83.5, 85.5, 85, 83, 88, and 87.5 mm. This agrees with the results obtained by Bangs and Peters,⁷¹ who do not regard *Phoenicurus schisticeps beicki* Stresemann as a valid race.

161. *PHOENICURUS HODGSONI* (Moore)

Ruticilla hodgsoni MOORE, Proc. Zool. Soc. London, 1854, p. 26, pl. 58 (Nepal).

Two males, Likiang Mountains, 10,000 feet, January–February; one male, mountains of Yungning, 12,000–13,000 feet, December; and two females, Ndamucho, 14,000 feet, October; all in Yunnan.

162. *PHOENICURUS FRONTALIS* Vigors

Phoenicura frontalis VIGORS, Proc. Zool. Soc. London, 1832, p. 172 (Himalaya).

Two males, Likiang Mountains, 10,000 feet, January–February; and October); six males, four females, and three young in the spotted plumage from southwest Szechwan (Muli Mountains, 10,000 feet, May; Mount Konka, 16,000 feet, June; back of Mount Mitzuga, 13,000 feet, Muli, June; Mount Gibboh, 13,000 feet, Muli, June; Raronki, Shouchu basin, 12,400 feet, Muli, August; Dshizhi, 13,500

⁷¹ Bull. Mus. Comp. Zool., vol. 68, p. 352, 1928.

feet, April; Yulonghsi Valley, 13,000–16,000 feet, May; Shangentze, 14,500 feet, May; Yulinggong, 11,000 feet, ten miles south of Tatsienlu, May).

Though a large series of specimens is available from China, only two adult males have been examined from the Himalayas. They are certainly very close to if not identical with some of the Chinese specimens in the same stage of wear, but the series is too small to decide the status of *P. f. sinae*, especially as I have examined no typical specimens of the latter from Kansu. Rothschild⁷² says the Yunnan specimens do not differ from those from the Himalayas, and Bangs and Peters,⁷³ who examined Kansu specimens, doubt the existence of a northern race.

163. *SAXICOLA TORQUATA PRZEWALSKII* (Pleske)

Pratincola maura var. *przewalskii* PLESKE, Wissenschaftliche Resultate der von N. M. Przewalski nach Central-Asien unternommenen Reisen, Vögel, vol. 1, p. 46, pl. 4, figs. 1–3, 1889 (Kansu).

Six males and five females, Yunnan (Likiang Mountains, January–February and September; mountains of Yungning, 12,000–13,000 feet, November–December); two males, southwest Szechwan (Mutirong, 7,000–7,800 feet, Yalung Gorge, April; Yulonghsi Valley, 13,000–16,000 feet, May).

164. *SAXICOLA TORQUATA STEJNEGERI* (Parrot)

Pratincola rubicola stejnegeri PARROT, Verh. Orn. Ges. Bayern, vol. 8, p. 124, 1908 (Iterup and Jesso, Japan).

One male, Mutirong, Yalung Gorge, 7,000–7,800 feet, southwest Szechwan, April.

165. *RHODOPHILA FERREA HARINGTONI* (Hartert)

Oreicola ferrea haringtoni HARTEBT, Die Vögel der paläarktischen Fauna, vol. 1, Heft 6, p. 711, 1910 (Lien-kiang bei Futschau, China).

Two adult males and one immature male, northwest Yunnan (Likiang Mountains, September; Yulo, 7,000 feet, August; and Luddü Mountains, 12,000–13,000 feet, August); one female, forests of Shaya, northeast of Muli, 14,300 feet, southwest Szechwan, July.

166. *MONTICOLA SOLITARIA PANDOO* (Sykes)

Petrocincla pandoo SYKES, Proc. Zool. Soc. London, 1832, p. 87 (western Ghats).

Four males, Likiang Mountains, Yunnan, September and October, 1928.

⁷² Nov. Zool., vol. 33, p. 252, 1926.

⁷³ Bull. Mus. Comp. Zool., vol. 68, p. 351, 1928.

One specimen (U.S.N.M. No. 312428) has the under tail coverts chestnut and a median bar of the same color on some of the feathers of the center of the breast.

167. *CALLIOPE TSCHEBALIEWI* Przewalski

Calliope tschebaliewi PRZEWALSKI, Mongol i strana Tangut, vol. 2, p. 44, pl. 9, fig. 1, 1876 (mountains of Kansu); Rowley's Ornithological miscellany, vol. 2, pt. 6, p. 180, pl. 54, fig. 1, 1877.

Seven males and four females, Mount Konka, 16,000 feet, June; seven males and three females, Mount Mitzuga, Muli, 15,000 feet, June; one male, forests of Raronki, Shouchu Basin, 14,200 feet, August; one male, forests of Bonti, 13,500 feet, east of Waerhdje, July; one immature in the spotted plumage, Mount Konka (Mount Chanandodji), 15,600 feet, August; one male and two females, Yulonghsi, 13,000–16,000 feet, May; all in southwest Szechwan.

168. *OREOCINCLA MOLLISSIMA MOLLISSIMA* (Blyth)

Turdus mollissimus BLYTH, Journ. Asiat. Soc. Bengal, vol. 11, p. 188, 1842 (Darjeeling).

One adult male, one adult female, and one young female, northwest Yunnan (Likiang Mountains, 10,000 feet, January–February; Ndamucho, 14,000 feet, October; and Chütien, 6,500 feet, October); one young not long from the nest, southwest Szechwan (forests of Raronki, 12,400 feet, Shouchu Basin, north of Muli, August).

169. *CICHOSELYS SIBIRICUS SIBIRICUS* (Pallas)

Turdus sibiricus PALLAS, Reise durch verschiedene Provinzen des russischen Reichs, vol. 3, p. 694, 1776 (Dauria).

One adult female, Likiang Mountains, Yunnan, October, 1928. Apparently the first record for Yunnan.

170. *TURDUS EUNOMUS* Temminck

Turdus eunomus TEMMINCK, Nouveau recueil de planches coloriées d'oiseaux, pl. 514, 1831 (Japan).

One female, gorges of Lautsolö, 10,000 feet, November, and one female, Likiang Mountains, 10,000 feet, January–February, both in northwest Yunnan.

171. *TURDUS ATROGULARIS* Temminck

Turdus atrogularis TEMMINCK, Manuel d'ornithologie, vol. 1, p. 169, 1820 (rarely in Austria and Silesia).

One adult male, Likiang Mountains, 10,000 feet, January–February.

In this specimen the tail feathers are suffused with ochraceous-tawny on the inner web on the underside; very pronounced on the

outer feather, where it shows from above also as an irregular blotch at the tip.

172. *TURDUS RUFICOLLIS* Pallas

Turdus ruficollis PALLAS, Reise durch verschiedene Provinzen des russischen Reichs, vol. 3, p. 694, 1776 (Dauria).

Eighteen males and seven females, northwest Yunnan (Likiang Mountains, 10,000–11,000 feet, January–February; Yungning Mountains, 12,000–13,000 feet, November–December; and Yungning Plain, 9,500 feet, November–December); three males and three females, southwest Szechwan (Muli, 10,500 feet, December; Mutirong, Muli, 7,000–7,800 feet, April; Vudju, south of Muli and Mount Gibboh, 10,000 feet, April; Yetsi Valley, 12,000 feet, one day north of Kulu, April).

173. *TURDUS GOULDII* (Verreaux)

Merula gouldii VERREAUX, Nouv. Arch. Mus. Paris, vol. 6, Bull., p. 34, 1870 (West Szechwan).

Three males and two females, northwest Yunnan (Likiang Mountains, 11,000 feet, January; Gauwua Mountains, 11,500 feet, Yungning April; Luddü Mountains, 12,000–13,000 feet, August); four males, three females, and one immature, southwest Szechwan (Muli Mountains, 11,000 feet, May; Mount Mitzuga, 12,000 feet, June; forests of Bonti, east of Waerhdje, 13,000 feet, July; forests of Dshizhi, 13,500 feet, April; Yetsi Valley, one day north of Kulu, 12,000 feet, April; Brüolo-kong, 13,000–15,900 feet, May; Chüchulongba, 13,000–14,000 feet, no date).

A male from Mount Mitzuga (U. S. N. M. No. 312522) is very dark on the chest and flanks (somewhat darker than auburn), deepening on the breast and belly to dull black with auburn fringes to the feathers; the head and upperparts are somewhat darker than normal. In another male (U. S. N. M. 314332), the tips of the feathers of the mantle are tipped rather broadly with black. These are only abnormal, however.

There is no indication in the large series of this species in the United States National Museum of intergrades toward *castaneus*.

174. *TURDUS KESSLERI* (Przewalski)

Merula kessleri PRZEWALSKI, Mongol i strana Tangut, p. 62, pl. 10, 1876 (Kun-su); Rowley's Ornithological miscellany, vol. 2, pt. 6, p. 199, 1877.

One male, Mount Mitzuga, 14,600 feet, Muli, June; one male, Yulonghsi, 13,000–16,000 feet, May; and one male, Chengtze, 14,500–15,900 feet, May, all in southwest Szechwan.

175. *TURDUS OBSCURUS* Gmelin

Turdus obscurus GMELIN, Systema naturae, vol. 1, pt. 2, p. 816, 1789 (east of Lake Baikal).

One male, Shintsang, 11,000 feet, Yunnan, September.

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176. OLIGURA CASTANECORONATA DEJEANI (Oustalet)

Cryptolopha dejeani OUSTALET, Bull. Mus. Paris, 1896, p. 316 (Tatsienlu, Szechwan).

One female, back of Mount Mitzuga, 13,000 feet, Muli, southwest Szechwan, June.

Two males, and four females before me from China agree in being more olive-green above, the pileum lighter chestnut, and the lower-parts a lighter yellow than a single specimen examined from Sikkim. The Chinese specimens are considerably larger. The wings of the six Chinese specimens measure 52.5–56 mm. (54.7); the single Sikkim specimen, 47.5 mm.

177. SUYA CRINIGERA CATHARIA (Reichenow)

Prinia catharia REICHENOW, Orn. Monatsb., vol. 16, p. 13, 1908 (Ta-sieng-lu-ting, Szechwan).

Six males and one unsexed, southwest Szechwan (Mutirong, 7,000–7,800 feet, Muli, April).

The above series belongs with the birds that I formerly identified as *S. c. yunnanensis*.⁷⁴ This is not surprising, as the above locality is not so very far off across the Yangtze in the Yalung Gorge. A male from Ningyuanfu, Szechwan, in the National Museum, also seems to belong here. A male from Kiating has the margins of the feathers of the upperparts more brownish than in the Muli series, but it was taken late in June, and this difference may be seasonal. It matches a male from the Likiang Mountains taken in July. If *S. c. yunnanensis* is recognizable, it must be confined to western Yunnan and eastern Burma. The six males from Muli measure: Wing, 46–48 (47); culmen, 10.5–11 (10.7) mm.

178. CISTICOLA JUNCIDIS CURSITANS (Franklin)

Prinia cursitans FRANKLIN, Proc. Zool. Soc. London, 1831, p. 118 (between Calcutta and Benares).

One male, Yungning Plain, 9,300 feet, northwest Yunnan, May.

This specimen does not differ appreciably from birds from Shanghai, in size or color. I have examined only one bird from India, but Stuart Baker⁷⁵ assigns Yunnan birds to this race. If the eastern Chinese specimens belong to the same race, as the material in the United States National Museum seems to show, then *Calamanthella tinnabulans* Swinhoe⁷⁶ must become a synonym. The wing

⁷⁴ Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 46, 1926.

⁷⁵ Fauna of British India, Birds, ed. 2, vol. 2, p. 422, 1924.

⁷⁶ Journ. Asiat. Soc. North China Branch, vol. 1, p. 225, 1859.

of the above specimen measures 51 mm. The wings of seven males from the vicinity of Shanghai measure 51-55 (53.3) mm. Since the above was written, Lynes's review of the genus *Cisticola*⁷⁶ has appeared, and he recognizes *tinnaulans* as the name to use for the breeding bird of southeast China, but on page 96 he says that in western Yunnan the birds fuse with the Burmese races.

179. *DUMETICOLA THORACICA THORACICA* Blyth

Dumeticola thoracica BLYTH, Journ. Asiat. Soc. Bengal, vol. 14, p. 584, 1846 (Nepal).

Four males and one female, southwest Szechwan (Mount Mitzuga, 13,000-15,000 feet, Muli, June; back of Mount Mitzuga, 13,500 feet, June; forests of Raronki, 14,200 feet, Shouchu Basin, August).

The above female practically lacks the dusky spots on the jugulum; there is another specimen (U. S. N. M., No. 297122) that approaches it from the Likiang Mountains. The female seems to have fewer spots on the jugulum, anyway, but they are rarely lacking.

180. *HOREITES BRUNNIFRONS UMBRATICUS* Baker

Horeites brunneifrons umbraticus BAKER, Bull. Brit. Orn. Club, vol. 44, p. 63, 1924 (Sheweli-Salwin Divide, Yunnan).

One male and one female, Mount Mitzuga, 13,000 feet, Muli, southwest Szechwan, June.

181. *HORORNIS MAJOR* (Moore)

Horeites major MOORE, Proc. Zool. Soc. London, 1854, p. 105 (Nepal).

One male, Mount Mitzuga, 13,500 feet, Muli, southwest Szechwan, June.

It measures: Wing, 65; tail, 50; culmen, 12 mm.

182. *HORORNIS ACANTHIZOIDES ACANTHIZOIDES* (Verreaux)

Abornis acanthizoides VERREAUX, Nouv. Arch. Mus. Paris, vol. 6, Bull., p. 37, 1870 (mountains of Chinese Tibet).

One female, forests west of Yungning, 13,000 feet, Yunnan, May, and one female, Mount Gibboh, 13,000 feet, south of Muli, 13,000 feet, southwest Szechwan, August.

183. *SEICIRUS BURKII DISTINCTUS* (LaTouche)

Cryptolopha burkii distincta LATOUCHE, Bull. Brit. Orn. Club, vol. 32, p. 41, 1922 (Mengtz, Yunnan).

One adult male, Mount Mitzuga, 11,000 feet, Muli, June, and one immature male, Noñ forests, east of Muli, 10,500 feet, southwest

⁷⁶ Ibis, suppl. no., Sept., 1930.

Szechwan, August; one adult, Fuchuanshan, 10,000–12,000 feet, Yunnan, September.

The wing of the adult male measures 53.5 mm. Two males from the Likiang Mountains, Yunnan, taken in May and August, measure: Wing, 54–55.5 mm.; one male, apparently of this race, from near Ningyuanfu, Szechwan, has the wing 50 mm. This is a slight extension northward of the breeding range. Just where the present race meets *valentini* is not known; the United States National Museum has breeding specimens of the latter from Mount Omei, near Washan, and Wenchwan, Szechwan, but they are probably not typical, as the wing measurement is not so great as that given by Bangs for the form.⁷⁷ Breeding birds are much lighter below than before the breeding season.

184. *SEICIRCUS BURKII VALENTINI* (Hartert)

Cryptolopha burkii valentini HARTERT, Die Vögel der paläarktischen Fauna, vol. 1, Heft 4, p. 497, 1907 (Taipaishan, Shensi).

Three males, one female, and one unsexed, Likiang Mountains, Yunnan, October.

These are evidently migrants from the north. Two of the adult males have a wing measurement of 63 and 61 mm.; the female, 57 mm. The foreheads of all are tinged with yellowish green.

185. *PHAEORHADINA FUSCATA ROBUSTA* (Stresemann)

Phylloscopus fuscatus robustus STRESEMANN, Abh. Ber. Mus. Tierk. Völkerk. Dresden, vol. 16, no. 2, p. 16, 1924 (Sungpan, Szechwan).

One male, Weihsu, 8,000–9,000 feet, northwest Yunnan, September.

This specimen is darker above and paler below than the form that migrates through eastern China. It is a bird of the year; the belly slightly tinged with very pale yellow and may not belong here at all, but I do not think it belongs with the east China form (*fuscata*).

186. *PHAEORHADINA AFFINIS* (Tickell)

Motacilla affinis TICKELL, Journ. Asiat. Soc. Bengal, vol. 2, p. 576, 1833 (jungles of Borabhum and Dholbhum).

Five males and one female, southwest Szechwan (Mount Mitzuga, Muli, 12,500 feet, June; Mutirong, 7,000–7,800 feet, Muli, April; Yanwekong, 10,700 feet, May; Yulonghsi, 13,000–16,000 feet, May).

187. *PHAEORHADINA SUBAFFINIS* (Grant)

Oreopneuste subaffinis GRANT, Bull. Brit. Orn. Club, vol. 10, p. 37, 1900 (Pu-anting, southwest Kweichu).

One unsexed, Mutirong, 7,000–7,800 feet, Muli, southwest Szechwan, April.

⁷⁷ Proc. New England Zool. Club, vol. 11, p. 3, 1929.

188. OREOPNEUSTE ARMANDI (Milne-Edwards)

Abornis armandi MILNE-EDWARDS, Nouv. Arch. Mus. Paris, vol. 1, Bull., p. 2, pl. 2, fig. 1, 1865 (north China).

Two females, northwest Yunnan (Likiang Mountains, October; and Fuchuan Shan, 10,000–12,000 feet, September); one male and one female, southwest Szechwan (Mutirong, 7,000–7,800 feet, Muli, April; Chiu-lung-hsien, halfway between Muli and Tatsienlu, May).

189. PHYLLOSCOPUS TROCHILOIDES (Sundevall)

Acanthiza trochiloides SUNDEVALL, Physiographiska Sällskapets Tidskrift, vol. 1, p. 76, 1837 (Calcutta, India).

One female, Likiang Mountains, 11,000 feet, Yunnan, September.

This specimen was taken with *P. magnirostris*, which it greatly resembles in color, but is smaller. It measures: Wing, 55; culmen, 10; tarsus, 19 mm.

Count Gyldenstolpe has recently shown ⁷⁸ that *Phylloscopus lugubris* auct. and *Acanthiza trochiloides* Sundevall are the same.

190. PHYLLOSCOPUS REGULOIDES CLAUDIAE (LaTouche)

Acanthopneuste trochiloides claudiae LATOUCHE, Bull. Brit. Orn. Club, vol. 43, p. 22, 1922 (Mengtz, Yunnan).

Five males, three females, and two unsexed, northwest Yunnan (Likiang Mountains, September and October; Luddü Mountains, 12,000–13,000 feet, August; Fuchuan Shan, 10,000–12,000 feet, September; Ndamucho, 14,000 feet, October); two males and six females, southwest Szechwan (Bonti, east of Waerhdje, 12,500 feet, July; forests of Baude, northeast of Muli, 13,000 feet, July; Noön forests, east of Muli, 10,500 feet, August).

The United States National Museum contains specimens of this race from as far north in Szechwan as Wenchwan taken in early August. Doctor Rock's specimens from southwest Szechwan taken in summer are also evidently breeding birds, and on a previous trip he took it in the breeding season in the Likiang Mountains, Yunnan. This would make it the breeding form over the high mountains of western China from northern Szechwan, at least, to northwest Yunnan.

191. PHYLLOSCOPUS MAGNIROSTRIS Blyth

Phylloscopus magnirostris BLYTH, Journ. Asiat. Soc. Bengal, vol. 12, p. 966, 1843 (Calcutta, India).

One male, three females, and one unsexed, northwest Yunnan (Likiang Mountains, September; forests of Gowa, 10,000 feet, May;

⁷⁸ Bull. Brit. Orn. Club, vol. 46, p. 47, 1925; and Arkiv für Zool., Band 19A, no. 1, p. 47, 1926.

and Luddü Mountains, 12,000–13,000 feet, August); seven males and three females, southwest Szechwan (Mount Mitzuga, 13,500 feet, Muli, June; Mount Konka, 14,000 feet, June; forests above Djishi, Yalung watershed, northeast of Muli, July; forests of Bonti, east of Waerhdje, 12,500 feet, July; and Tatsienlu, 9,500–10,000 feet, May). The male (U. S. N. M. No. 314417) from Tatsienlu has a large yellowish-white partially concealed patch on the occiput. It is unique in a large series of the species in the National Museum.

192. *REGULOIDES PROREGULUS FORRESTI* (Rothschild)

Phylloscopus proregulus forresti ROTHSCILD, Nov. Zool., vol. 28, p. 45, 1921 (Likiang Mountains, Yunnan).

One male, Likiang Mountains, Yunnan, September, and three males and one female from southwest Szechwan (Mount Gibboh, 13,000 feet, Muli, May; Mount Mitzuga, 13,000 feet, Muli, June; Mutirong, 7,000–7,800 feet, Muli, April).

The United States National Museum contains specimens of this race from as far north as Sungpan, Szechwan.

193. *REGULOIDES PULCHER PULCHER* (Blyth)

Phylloscopus pulcher BLYTH, Journ. Asiat. Soc. Bengal, vol. 14, p. 592, 1845 (Nepal).

One male and one female, Likiang Mountains, Yunnan, October; one male, Mount Konka, 14,500 feet, June; and one unsexed, Yanwekong Valley, 10,000–12,000 feet, May, southwest Szechwan.

I can not distinguish between breeding specimens taken in the Likiang Mountains, Yunnan, and at Sungpan, Szechwan. It may be that all Chinese records of this species should belong to *Reguloides pulcher vegetus* Bangs,⁷⁹ but for the present I am following Stuart Baker,⁸⁰ as no specimens from Nepal have been examined by me.

194. *REGULUS REGULUS YUNNANENSIS* Rippon

Regulus yunnanensis RIPPON, Bull. Brit. Orn. Club, vol. 19, p. 19, 1906 (Yangtze River, west Yunnan).

Six males and three females, Likiang Mountains, 10,000 feet, northwest Yunnan, January–February.

This dark race extends north as far as Sungpan at least, as the United States National Museum contains a male and two young from there.

195. *LEPTOPOECILE SOPHIAE OBSCURA* Przewalski

Leptopoecile obscura PRZEWALSKI, Zapiski Imp. Akad. Nauk St. Petersburg, vol. 55, p. 80, 1887 (northeast Tibet).

Leptopoecile henrici OUSTALET, Ann. Sci. Nat., ser. 7, vol. 12, p. 287, pl. 10, fig. 1, 1891 (Aktaroma, between Kurla and Lob-nor, Tibet).

⁷⁹ Proc. Biol. Soc. Washington, vol. 26, p. 95, 1913.

⁸⁰ Fauna of British India, Birds, ed. 2, vol. 2, p. 464, 1924.

Five males and seven females from southwest Szechwan (Mount Mitzuga, 14,500–15,000 feet, Muli, June; Mount Konka, 14,800–16,000 feet, June and August; forests above Djishi, 12,000 feet, July; forests of Raronki, 12,400 feet, north of Muli, August; Yulonghsi, 13,000–16,000 feet, May; Chengtze, 14,500–15,900 feet, May; Yanwek-kong, 10,700 feet, May).

This bird is so different in color from *Leptopoecile sophiae* that it seems to me it should be recognized as a species. Sex for sex it is much darker, and the blue of the rump is not so bright; the breast and belly are a vinaceous-brown with a blue wash instead of a pinkish buff. It is also smaller.

Family MUSCICAPIDAE, Flycatchers

196. *CULICICAPA CEYLONENSIS CALOCHRYSEA* Oberholser

Culicicapa ceylonensis calochrysea OBERHOLSER, Smithsonian Misc. Coll., vol. 76, no. 6, p. 8, July 16, 1923 (Quaymos, Tenasserim).

Culicicapa ceylonensis orientalis STUART BAKER, Bull. Brit. Orn. Club, vol. 44, no. 281, p. 11, Nov. 5, 1923 (Szechwan).

One male and two females, northwest Yunnan (forests of Gowa, 10,000 feet, May; Luddü Mountains, 12,000–13,000 feet, August; Fuchuanshan, 10,000–12,000 feet, September).

In the report upon Doctor Rock's previous collection from Yunnan,⁸¹ I assigned a single specimen from the Likiang Mountains to *Culicicapa ceylonensis orientalis* Baker, overlooking the fact that *Culicicapa ceylonensis calochrysea* Oberholser was an earlier name proposed for the same form. The United States National Museum now contains a fair series of this species from western Szechwan. These and the Yunnan specimens when compared with Tenasserim birds do not seem to differ racially in color or size.

197. *EUMYIAS THALASSINA THALASSINA* (Swainson)

Muscicapa thalassina SWAINSON, Natural history of flycatchers, Naturalist's Library, vol. 10, Ornithology, p. 252, 1838 (India).

One male, Likiang Mountains, September; and two females, Yulo, 7,000 feet, Yunnan, August.

198. *CYORNIS RUBECULOIDES GLAUCICOMANS* Thayer and Bangs

Cyornis tickelliae glaucicomans THAYER and BANGS, Bull. Mus. Comp. Zool., vol. 52, p. 141, 1909 (Tanswioyah, Hupeh, China).

One male, Muli Mountains, 10,000 feet, southwest Szechwan, May.

The above specimen has the lesser wing coverts a shining Venetian blue, but this seems to vary considerably in three males from Mount Omei; the wing measures 76 mm.

⁸¹ Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 19, 1926.

199. *NILTAVA SUNDARA DENOTATA* Bangs and Phillips

Niltava sundara denotata BANGS and PHILLIPS, Bull. Mus. Comp. Zool., vol. 58, p. 280, 1914 (Mengtsze, Yunnan).

Three adult males, two immature males, and one immature female, northwest Yunnan (Likiang Mountains, October; Fungkou, 9,000 feet, May; Luddü Mountains, 12,000–13,000 feet, August; Fuchuan-shan, 10,000–12,000 feet, September); one adult male and one immature female, southwest Szechwan (Yanwekong, 10,000–12,000 feet, May; forests of Noön, east of Muli, 10,500 feet, August).

The two immature males and the two immature females are in the spotted plumage. The United States National Museum contains two additional immature males in the spotted plumage from Doctor Rock's first expedition in Yunnan. The immature males vary somewhat in plumage and are probably not quite the same age, though approximately so. Irrespective of the slight age variations in these immature males, they all have the blue tail like the adult. One specimen is acquiring a blue rump and has a few blue feathers on the nape and lesser wing coverts; the Mars-yellow breast is being acquired in the two lateral feather tracts; the remiges are new and are blue outwardly at the base only, brownish toward the tip. The adult male plumage evidently is acquired at the first molt, except for the remiges. The two immature females in the spotted plumage of apparently the same age as the above spotted immature males have the tail brown like the adult female; they also have the white jugular patch and the white belly of the adult female. None of the spotted males has the jugular patch or belly white, but fulvous. Now in these two spotted females the remiges are new and resemble those of the adult female. All these spotted young, whether male or female, have acquired the tail of the first winter plumage. The interesting point is that the sexes become differentiated at a very early stage. They are probably only similar in the nestling plumage and the series of young before me seems to indicate that the female even then differs from the male in having the jugular patch and belly white.

200. *SIPHIA STROPHIATA* Hodgson

Siphia strophciata HODGSON, Indian Rev., vol. 1, p. 651, 1837 (Nepal).

One male from northwest Yunnan (Yungning, 12,000 feet, May); three males and three females from southwest Szechwan (forests of Muli, 10,000 feet, May; forests of Djishigotong, Yalung Basin, northeast of Muli, 13,000 feet, July; Dshizhi, 13,500 feet, April; Yanwekong, 10,000–12,000 feet, May).

201. *SIPHIA PARVA ALBICILLA* (Pallas)

Muscioapa albicilla PALLAS, Zoographia Rosso-Asiatica, vol. 1, p. 462, 1811 (Dauria).

Four males and two females, Likiang Mountains, Yunnan, October and September.

202. *DIGENEA TRICOLOR CERVINIVENTRIS* Sharpe

Digenea cerviniventris SHARPE, Catalogue of birds in the British Museum, vol. 4, p. 460, 1879 (Manipur Hills).

One male, Likiang Mountains, Yunnan, October.

203. *MUSCICAPULA SUPERCILIARIS ASTIGMA* (Hodgson)

Muscicapa astigma HODGSON, in Gray's Zoological miscellany, p. 84, 1844 (Nepal).

Two males and one female from southwest Szechwan (Mount Mitzuga, 13,000 feet, Muli, June; forests of Shaya, northeast of Muli, July; forests above Baude, 12,500 feet, northeast of Muli, July); one female, Fuchuanshan, 10,000–12,000 feet, northwest Yunnan, September.

204. *POLIOMYLAS HODGSONI* (Verreaux)

Siphia hodgsoni VERREAUX, Nouv. Arch. Mus. Paris, vol. 6, Bull., p. 34, 1870 (Mountains of Chinese Tibet).

Six adult males, one adult female, and two immature males, southwest Szechwan (Mount Mitzuga, 13,000 feet, Muli, June; forests of Djishi, 11,000 feet, northeast of Muli, Yalung watershed, July; Mount Konka, 14,500 feet, August; Yulinggong, 10 miles south of Tatsienlu, 11,000 feet, May).

205. *CHELIDORYNX HYPOXANTHA* (Blyth)

Rhipidura hypoxantha BLYTH, Journ. Asiat. Soc. Bengal, vol. 12, p. 935, 1848 (Darjeeling, India).

One adult male and one unsexed from northwest Yunnan (forests of Yungning, 13,000 feet, May; Likiang Mountains, October); one male from southwest Szechwan (Djishigotong, Yalung River watershed, northeast of Muli, 12,500 feet, July).

206. *HEMICHELIDON SIBIRICA ROTHSCILDI* Baker

Hemichelidon sibirica rothschildi BAKER, Bull. Brit. Orn. Club, vol. 43, p. 156, 1923 (Likiang Range, Yunnan).

One adult unsexed and one immature male, northwest Yunnan (Lapo-laze forests, 10,000 feet, May; Likiang Mountains, September).

The United States National Museum contains specimens of this race from as far north as Sungpan, Szechwan.

207. *HEMICHELIDON FERRUGINEA* Hodgson

Hemichelidon ferruginea HODGSON, Proc. Zool. Soc. London, 1845, p. 32 (Nepal).

One male and two females, southwest Szechwan (Mount Mitzuga, 12,000 feet, Muli, June; forests of Bonti, east of Waerhdje, 12,000 feet, July; Noön forest, 11,000 feet, east of Muli, August).

208. *RHIPIDURA ALBICOLLIS ALBICOLLIS* (Vieillot)

Platyrrhynchus albicollis VIEILLIOT, Nouv. Dict. d'Hist. Nat., vol. 27, p. 13, 1818 (Bengal).

One female, Shintsang, 11,000 feet, northwest Yunnan, September; and one male, Muli Valley, 10,000 feet, southwest Szechwan, June.

These specimens are darker even than the three specimens previously reported upon from Yunnan,⁸² and are quite different from the only two Indian skins available for comparison. It probably represents an unnamed race.

Family MOTACILLIDAE, Wagtails, Pipits

209. *ANTHUS SPINOLETTA JAPONICUS* Temminck and Schlegel

Anthus pratensis japonicus TEMMINCK and SCHLEGEL, Fauna Japonica, Aves, p. 59, pl. 24, 1847 (Japan).

One male, Likiang Mountains, 10,000 feet, Yunnan, January–February.

This seems to be the first record for Yunnan.

210. *ANTHUS HODGSONI* Richmond

Anthus hodgsoni RICHMOND, in Blackwelder, Research in China, vol. 1, part 2, p. 493, 1907 (new name for *Pipastes maculatus* JERDON, preoccupied; Nepal).

Four females, northwest Yunnan (Luddü Mountains, 12,000–13,000 feet, August; Fuchuanshan, 10,000–12,000 feet, September; Ndamucho, 14,000 feet, October); one male and two females, southwest Szechwan (Djishi, 11,500 feet, northeast of Muli, July; Mount Gibboh, 13,000 feet, Muli, August; Mutirong, 7,000–7,800 feet, Muli, April).

The July specimen is in very worn plumage; the olive wash has almost entirely disappeared from the upperparts, a little only remaining on the outer surface of the wings. All species of this genus undergo great changes in plumage in the breeding season.

⁸² Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 19, 1926.

Partly on this account it is very difficult to make out geographic forms. I am quite in sympathy with Bangs and Peters's⁸³ conclusions in regard to the nonrecognition of *A. h. yunnanensis* and *A. h. berezowskii*. The majority of specimens in collections have been taken on migration; enough breeding birds have not been examined to reach any definite conclusions in regard to the status of the forms.

211. *ANTHUS ROSEATUS* Blyth

Anthus roseatus BLYTH, Journ. Asiat. Soc. Bengal, vol. 16, p. 437, 1847 (Nepal).

One adult male, Mount Mitzuga, 15,000 feet, Muli, June; one adult male, one immature male, and two immature females, Mount Konka, 16,000–16,500 feet, June and August; two males, Dshizhi, Muli, 13,500 feet, April; one male, Mutirong, Muli, 7,000–7,800 feet, April; two males, Brüolo-kong Valley, 13,000–15,900 feet, May; one male, two females, and one unsexed, Shangentze, 14,500 feet, May; one female, Chengtze, 14,500–15,900 feet, May; one male, Barongomba, 11,000–12,000 feet, no date; all the above localities in southwest Szechwan. Two males, Ndamucho, Yangtze-Mekong Divide, 14,000 feet, Yunnan, October.

212. *ANTHUS RICHARDI RICHARDI* Vieillot

Anthus richardi VIEILLOT, Nouv. Dict. d' Hist. Nat., vol. 36, p. 491, 1818 (France).

One female, Likiang Mountains, Yunnan, September.

213. *ANTHUS RICHARDI GODLEWSKII* (Taczanowski)

Agrodroma godlewskii TACZANOWSKI, Bull. Soc. Zool. France, 1876, p. 128 (south Dauria).

One male, Mount Gibboh, 13,000 feet, Muli, southwest Szechwan, August.

This specimen is much more richly colored, especially below, than the specimen listed above as *Anthus r. richardi*; the streaks on the chest are heavier; and the hind claw is shorter. It measures: Wing, 91; hind claw, 13 mm. A male and an unsexed specimen taken near Kiating, Szechwan, in worn breeding plumage, June 2 and 27, are in the United States National Museum. They both have short hind claws, measuring 13 mm. in the male and 11.5 mm. in the unsexed specimen, and belong to the present form. A female from Tabool, eastern Mongolia, August 9, three males and one female from Kansu (near Ningsia, May 7 and 19, to the vicinity of Lanchow, July 16, and Labrang, August 31) are also of the short-clawed form. Two males and one unsexed from the vicinity of Ningsia, Kansu, May 7, are of the long-clawed variety. Either the two forms occur together on migration or else the short-clawed variety is only an individual

⁸³ Bull. Mus. Comp. Zool., vol. 68, p. 368, 1928.

variation. I am inclined to the latter belief, but breeding material is lacking to show that the two forms occur together in summer.

214. *BUDYTES CITREOLA WEIGOLDI* (Rensch)

Motacilla citreola weigoldi RENSCH, Abh. Ber. Tierk. Völkensk. Mus. Dresden, vol. 16, no. 2, p. 55, 1924 (Sungpan, Szechwan).

One male (marked female), Mount Mitzuga, 12,000 feet, Muli, southwest Szechwan, June.

This specimen does not have the black of the back extending so far posteriorly as in typical specimens from Sungpan, but has the lower back and rump deep neutral gray. Three males of typical *weigoldi* from Sungpan are not so deep a sooty black as *calcarata*, and the rumps are more extensively neutral gray. *B. c. weigoldi* does not appear to differ in size from *B. c. calcarata*. The above specimen measures: Wing, 88; culmen, 14 mm.

215. *BUDYTES CITREOLA CITREOLA* (Pallas)

Motacilla citreola PALLAS, Reise durch verschiedene Provinzen des russischen Reichs, vol. 3, p. 696, 1776 (east Siberia).

One immature, not sexed, northwest Yunnan (Ndamucho, 14,000 feet, October); three males and one female, southwest Szechwan (Dshizhi, 12,000 feet, April; Brüolo-kong Valley, 13,000–15,900 feet, May; Tatsienlu, 9,500–10,000 feet, May).

The spring adults are evidently on their way to the breeding grounds farther north. The immature bird may not belong to this form. It is darker above than the only immature specimen of about the same age that I have been able to compare it with; the bill is equally small, however.

216. *MOTACILLA CINEREA CASPICA* (S. G. Gmelin)

Parus caspicus S. G. GMELIN, Reise durch Russland, vol. 3, p. 104, pl. 20, fig. 2, 1774 (Enzeli, Caspian Sea).

Five males, one female, and one unsexed, northwest Yunnan (Likiang Mountains, September and October; Fuchuanshan, 10,000–12,000 feet, September).

217. *MOTACILLA LUGUBRIS LEUCOPSIS* Gould

Motacilla leucopsis GOULD, Proc. Zool. Soc. London, 1837, p. 78 (India).

One male and two females, northwest Yunnan (Likiang Mountains, September and October; Fuchuanshan, 10,000–12,000 feet, September).

218. *MOTACILLA LUGUBRIS ALBOIDES* Hodgson

Motacilla alboides HODGSON, Asiat. Res., vol. 19, p. 191, 1836 (Nepal).

Five males and three females, northwest Yunnan (Likiang Mountains, January–February and September; Yungning Mountains,

12,000–13,000 feet, November–December; Ndamucho, 14,000 feet, October); one male, southwest Szechwan (Noön forests, east of Muli, 10,500 feet, August).

The single specimen from Ndamucho, Yunnan, though marked as a male is probably a female, as the bill is quite small, measuring 14 mm.

Family ENICURIDAE, Fork-tails

219. ENICURUS LESCHENAULTI SINENSIS Gould

Enicurus sinensis GOULD, Proc. Zool. Soc. London, 1865, p. 665 (Shanghai).

Two males and one female from northwest Yunnan (Likiang Mountains, 10,000 feet, January–February, and forests of Gowa, 10,000 feet, May); one male and one female, southwest Szechwan (Noön forests, east of Muli, 10,500 feet, August; and Vudju, 10,000 feet, south of Muli and Mount Gibboh, April).

Family LANIIDAE, Shrikes

220. LANIUS SPHENOCERCUS GIGANTEUS Przewalski

Lanius giganteus PRZEWAŁSKI, Zapiski Imp. Akad. Nauk St. Petersburg, vol. 55, p. 86, 1887 (Gelben River).

Two females, southwest Szechwan (Muli, 10,000 feet, December, and Bonti, 14,300 feet, July).

The above two females are larger and darker above than *L. s. sphenocercus*, and the chest and breast are a pale vinaceous-fawn. A few specimens of *L. s. sphenocercus* sometimes have a faint tinge of the latter color below, but as a rule they are more or less pure white on the chest and breast. The two Szechwan females measure: Wing, 137.5 and 139 mm.

The specimen taken in July is probably a breeding bird and comprises considerable extension of the range to the southward. It is probably a local breeding bird at high elevations in western China from western Kansu to southwest Szechwan and probably northwest Yunnan.

221. LANIUS TEPHRONOTUS (Vigors)

Collurio tephronotus VIGORS, Proc. Zool. Soc. London, 1831, p. 43 (Himalaya).

Four males, one female, and one unsexed, Yunnan (Likiang Mountains, January–February, September and May 8); five adult males, two adult females, and three immatures, southwest Szechwan (Mount Mitzuga, 12,000 feet, Muli, June; Djishi, 11,000 feet, Yalung basin, July; Muli-Yunnan border, 11,000 feet, August; Dshizhi, 13,500 feet, April; Yulonghsi, 13,000–16,000 feet, May; Brüolo-kong Valley, 13,000–15,900 feet, May; Yulinggong, 11,000 feet, May); one adult female, without locality.

Family STURNIDAE, Starlings

222. ACRIDOTHERES TRISTIS TRISTIS (Linnaeus)

Paradisea tristis LINNAEUS, Systema naturae, ed. 12, p. 167, 1766 (Philippine Islands, error; Calcutta).

One male, mountains of Yungning, 12,000–13,000 feet, November–December; and one male, Ndamucho, 14,000 feet, northwest Yunnan, October.

Family NECTARINIIDAE, Sun-birds

223. AETHOPYGA DABRYII DABRYII (Verreaux)

Nectarinia dabryii VERREAUX, Rev. Mag. Zool., p. 173, pl. 15, 1867 (Szechwan).

Two males and one female, Yunnan (Chinhaitze, Laposhan, 11,300 feet, May; Mbayiwua, 10,000 feet, April; Weihsi, 8,000–9,000 feet, September); 10 males and 3 females, southwest Szechwan (Vudju Mountains, south of Muli, 10,000 feet, May; back of Mount Mitzuga, Muli, 12,000 feet, June; Mount Mitzuga, 13,000 feet, June; Muli Mountains, 10,000 feet, June; forests of Baude-Shaya, 12,500 feet, northeast of Muli, July; Dshizhi, 13,500 feet, April; Shangentze, 14,500 feet, May; Yanwekong Valley, north of Wanzanron, 10,000–12,000 feet, May).

The specimen from Weihsi, though marked as a female, is probably a young male. The feathers of the chest are becoming faintly tinged with orange, and the base of the lower mandible for about two-thirds of its length is chamois. Possibly it may not belong to this species.

Family DICAËIDAE, Flower-peckers

224. PACHYGLOSSA MELANOZANTHA Blyth

Pachyglossa melanozantha BLYTH, Journ. Asiat. Soc. Bengal, vol. 12, p. 1010, 1843 (Nepal).

Fourteen males and three females, northwest Yunnan (Likiang Mountains, 12,000 feet, September; Luddü Mountains, 12,000–13,000 feet, August; Yulo, 7,000 feet, August; and one immature male, southwest Szechwan (Noön forests, 10,500 feet, east of Muli, August).

225. DICAËUM IGNIPECTUM IGNIPECTUM (Blyth)

Myzanthe ignipectus BLYTH, Journ. Asiat. Soc. Bengal, vol. 12, p. 983, 1843 (Nepal and Bhutan).

Two males and five females from southwest Szechwan (Muli Mountains, 10,000 feet, June; Mount Mitzuga, Muli, 10,000 feet, June; forests of Noön, 11,000 feet, east of Muli, August).

Family ZOSTEROPIDAE, White-eyes

226. ZOSTEROPS PALPEBROSA SIMPLEX Swinhoe

Zosterops simplex SWINHOE, Ibis, 1861, p. 331 (Amoy, China).

One male and two females, Muli Mountains, 10,000 feet, southwest Szechwan, June; one male, Luddü Mountains, 12,000–13,000 feet, Yunnan, August.

Family FRINGILLIDAE, Sparrows

227. MYCEROBAS CARNIPES (Hodgson)

Coccothraustes carnipes HODGSON, Asiat. Res., vol. 9, p. 151, 1836 (Nepal).

One male and six females, Yunnan (forests of Gowa, 10,000 feet, south of Yuli, May; Likiang Mountains, 9,600–13,500 feet, January); eight adult males, one immature male, and four females, Szechwan (Mount Mitzuga, 13,000–13,500 feet, June; Brüolo-kong Valley, north of the Druduron Pass, 13,000–15,900 feet, May; Yulinggong, 10 miles south of Tatsienlu, 11,000 feet, May).

228. MYCEROBAS MELANOXANTHUS (Hodgson)

Coccothraustes melanoxanthus HODGSON, Asiat. Res., vol. 9, p. 150, 1836 (Himalayas).

One male from northwest Yunnan (forests of Gowa, 10,000 feet, south of Yuli, May); two males and two females from southwest Szechwan (Muli Mountains, 10,000 feet, June; Mount Mitzuga, 13,000 feet, Muli, June; back of Muligomba, 10,000 feet, Muli, June).

229. PERISSOSPIZA AFFINIS (Blyth)

Hesperiphona affinis BLYTH, Journ. Asiat. Soc. Bengal, vol. 24, p. 179, 1855 (Sikkim).

One male, southwest Szechwan (back of Mount Mitzuga, 13,000 feet, Muli, June); two males and four females. Yunnan (Likiang Mountains, 13,500 feet, January; Luddü Mountains, 12,000–13,000 feet, August).

230. PROCARDUELIS RUBESCENS SATURATIONIS Rothschild

Procarduelis rubescens saturationis ROTHSCHILD, Bull. Brit. Orn. Club, vol. 32, p. 12, 1922 (Shewell-Salwin Divide, Yunnan).

One adult male, Likiang Mountains, 10,000 feet, Yunnan, January–February; and one adult female, Mount Mitzuga, 13,000 feet, Muli, southwest Szechwan, June.

231. PROCARDUELIS NIPALENSIS INTENSICOLOR Baker

Procarduelis nipalensis intensicolor BAKER, Bull. Brit. Orn. Club, vol. 45, p. 92, 1925 (Mekong-Salwin Divide, Yunnan).

One adult male and two females, valley above Djobi, 12,000 feet, southwest Szechwan, July.

232. *CARPODACUS MURATI* Delacour

Carpodacus erythrinus murati DELACOUR, Bull. Brit. Orn. Club, vol. 47, p. 20, 1926 (Noug-Het, Laos).

One adult male, Weihsi, 8,000–9,000 feet, northwest Yunnan, September.

As this specimen was unlike any species of the genus known to me from China, I took it to be an unnamed form and forwarded it to Outram Bangs for his opinion. He has identified it as above and writes: "Your bird is just completing its autumnal molt. It is rather darker above than the run of the series and the back feathers have rather less brownish edges. All this may be due to the freshness of the plumage or it may not."

He also says that the Museum of Comparative Zoölogy has a series from southern Yunnan (Mengtsz). It apparently is only a winter visitor to southern Yunnan and Laos. Where it breeds is apparently unknown. The present record is the farthest north point from which it has been taken, so far as I am aware, and would seem to point to a breeding range in eastern Tibet or the high mountains of western Szechwan.

This bird is so very different from *Carpodacus erythrinus* or any of its known forms that I am of the opinion that it is really not a race of that species at all but a distinct species. In *C. murati* the pileum is near acajou red and the throat alizarine pink, while in *C. erythrinus roseatus* the pileum and throat are near spectrum red; the two birds are of about the same size, however. The above specimen of *C. murati* measures: Wing, 81; tail, 52; culmen, 12 mm.

It seems to me that the type of *Carpodacus laetissimus* Walton⁸⁴ from Chaksam, Tibet, should be compared with the present species.

233. *CARPODACUS EOS* (Stresemann)

Erythrura eos STRESEMANN, Orn. Monatsb., vol. 38, p. 75, 1930 (Sungpan, Szechwan).

Three males and five females from southwest Szechwan (Mount Mitzuga, 14,500 feet, Muli, June; Bonti, east of Waerhdje, 13,000 feet, July; Mount Konka, 15,700–16,000 feet, August; Shelän, 13,400 feet, Muli, April; Mundon, 13,000 feet, May; Chüchulongba Valley, north of Tanku, 13,000–14,000 feet, no date).

The wings of the three males measure 75, 75, and 75.5 mm.; the five females, 71.5, 72, 73, 73.5, and 73.5. The females of the present species and the same sex of *C. argyrophrys* are extremely hard to differentiate, and for the present their identification will have to depend upon size. The five females identified above as this species are certainly lighter below and less heavily streaked than the females

⁸⁴ Bull. Brit. Orn. Club, vol. 15, p. 93, 1905.

listed as *C. argyrophrys*, but whether these differences would hold in a larger series is problematical.

234. *CARPODACUS ARGYROPHRYS* Berlioz

Carpodacus argyrophrys BERLIOZ, Bull. Mus. Paris, ser. 2, vol. 1, no. 2, p. 131, 1929 (new name for *Carpodacus davidianus* Authors, not Milne-Edwards).

Three males and six females from southwest Szechwan (forests of Djishigotong, 12,500–13,000 feet, northeast of Muli, July; valley of the Yalung River above Reddo, 11,000 feet, July; forests of Bonti, east of Waerhdje, 13,000 feet, July; Raronki, Shouchu Basin, north of Muli, August; Yulonghsi Valley, 13,000–16,000 feet, May); one female, Yunnan (Mbayiwua, Yangtze loop, 10,000 feet, April).

Bangs and Peters⁸⁵ have recently given the differential characters between the present species and *Carpodacus pulcherrimus* (*eos* Stresemann), so they need not be repeated here. The wings of the three males measure 82–85 (83.7) mm.; the seven females, 80.5–83.5 (82).

235. *CARPODACUS THURA FEMININUS* Rippon

Carpodacus femininus RIPPON, Bull. Brit. Orn. Club, vol. 19, p. 31, 1906 (Yangtze River, west Yunnan).

Twenty-one males and nineteen females from southwest Szechwan (mountains of Kulu, 11,000–13,000 feet, December and April; Muli Mountains, 10,000 feet, May; Mount Gibboh, 13,000 feet, Muli, May; Mount Mitzuga, 13,000–15,500 feet, Muli, June; back of Mount Mitzuga, 14,500 feet, June; Mount Konka, 15,600–16,500 feet, June; Watogomba, Yalung watershed, 12,500 feet, July; Djishigotong, 12,500–13,500 feet, northeast of Muli, July; Chide, 14,500 feet, northeast of Muli, July; Bonti, east of Waerhdje, 12,500 feet, July; Ronapien, Shouchu Basin, north of Muli, August; Raronki, Shouchu Basin, 12,600 feet, north of Muli, August; Shelän, Muli, 13,400 feet, April; Aloching, north of Kulu, Muli, 12,500–13,500 feet, April; Brüolokong Valley, north of the Druduron Pass, 13,000–15,900 feet, May; Shangentze, base of Druduron Pass, 14,500 feet, May; Yanwekong Valley, north of the Wanzanron Pass, 10,000–12,000 feet, May); one male and one female, Likiang Mountains, 11,000 feet, Yunnan, January.

Three males from Kansu are lighter above and smaller than specimens from the mountains farther south. With more ample material than available when the Yunnan collection of Doctor Rock was worked up,⁸⁶ I now think that the breeding bird of western Szechwan as far north as Sungpan will have to be assigned to the southern form. The 3 males from Kansu have wings 80–82 (81.3) mm.; 6

⁸⁵ Bull. Mus. Comp. Zool., vol. 68, p. 374, 1928.

⁸⁶ Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 57, 1926.

males from western Szechwan (near Tatsienlu, 2; Sungpan, 4), 84–86.5 (85.5); 18 males from southwest Szechwan (Muli or vicinity), 83–90 (86).

This brings up a complication in the name for the southern form, for Oustalet named *Carpodacus dubius* var. *minor* from Rata, Tibet, and Tatsienlu, Szechwan.⁸⁷ He gives the wing as 83 mm., and it may be that his type was only a migrant from farther north.

Males taken in winter are more of an old rose below without the carmine wash observable in breeding males, and the silvery pink shaft lines of the throat become much reduced by wear until they almost entirely disappear in July birds. This makes it necessary to use specimens taken at approximately the same season or in the same state of wear when comparing the various supposed geographic forms.

236. *CARPODACUS EDWARDSII SATURATUS* Blanford

Carpodacus saturatus BLANFORD, Journ. Asiat. Soc. Bengal, vol. 41, pt. 2, p. 168, pl. 8, 1872 (Tonglu).

One adult female, mountains of Yungning, 12,000–13,000 feet, Yunnan, November–December.

In a former paper⁸⁸ an unsexed specimen from the Tseh Chung Mountains, Mekong Valley, Yunnan, was referred doubtfully to *Carpodacus ripponi* (= *verreauxii*); this was a mistake. It is a female of the present form.

237. *CARPODACUS RUBICILLOIDES RUBICILLOIDES* Przewalski

Carpodacus rubicilloides PRZEWALSKI, Mongol i strana Tangut, vol. 2, 90, pl. 12, 1876 (mountains of Kansu); Rowley's Ornithological miscellany, vol. 2, p. 299, pl. 54, 1877 (translation).

Two males and one female, Yulonghsi, 13,000–16,000 feet, May; one female, Minya Mountains, east of Yulonghsi, 14,500 feet, Szechwan, no date.

The above have been compared with a single male from Kansu. The Szechwan males have slightly larger bills, and the plumules over the nostrils are whitish; the same color as the forehead (pomegranate purple) in the Kansu male.

238. *CARPODACUS VERREAUXII* (David and Oustalet)

Propasser verreauxii DAVID and OUSTALET, Les oiseaux de la Chine, p. 355, 1877 (Moupin).

Propasser ripponi SHARPE, Bull. Brit. Orn. Club, vol. 13, p. 11, 1902 (Gyi-dzin-shan, West Yunnan). (See Berlioz, Bull. Mus. Paris, ser. 2, vol. 1, p. 129, 1929.)

⁸⁷ Nouv. Arch. Mus. Paris, ser. 3, vol. 6, p. 31, 1894.

⁸⁸ Proc. U. S. Nat. Mus., vol. 70, art. 5, p. 58, 1926.

One male and two females, Mount Mitzuga, 12,500–13,000 feet, Muli, southwest Szechwan, June; one male, Luddü Mountains, 12,000–13,000 feet, northwest Yunnan, August.

239. *CARPODACUS VINACEUS* Verreaux

Carpodacus vinaceus VERREAUX, Nouv. Arch. Mus. Paris, vol. 6, Bull., p. 39, 1870 (mountains of Chinese Tibet).

One adult female, forests of Shaya, northeast of Muli, 14,000 feet, southwest Szechwan, July; one adult female, Luddü Mountains, 12,000–13,000 feet, northwest Yunnan, August.

240. *CARPODACUS TRIFASCIATUS* Verreaux

Carpodacus trifasciatus VERREAUX, Nouv. Arch. Mus. Paris, vol. 6, Bull., p. 39, 1870 (mountains of Chinese Tibet).

One adult male, valley of Shenlä, Kulu-Djago, 12,000 feet, southwest Szechwan, December.

241. *PYRRHOSPIZA PUNICEA SZETSCHUANA* Bianchi

Pyrrhospiza punicea szetschuana BIANCHI, Bull. Acad. Sci. St. Petersburg, 1907, no. 6, p. 189 (southeast Kansu and northern Szechwan).

Thirteen males and twelve females from southwest Szechwan (Mount Mitzuga, 15,200–15,600 feet, Muli, June; Mount Konka, 16,000–16,500 feet, Muli, June; Mount Gibboh, 13,000–14,000 feet, Muli, April; Brüolo-kong Valley, north of Druduron Pass, 13,000–15,900 feet, May; Yankongran Pass, 15,500 feet, Muli, May; Chiprinla, 16,500 feet, July; Chengtze, 14,500–15,900 feet, May).

This series is being assigned to the above race upon geographic grounds. I have been able to compare it with *Pyrrhospiza punicea humii* from Kashmir and East Turkestan, from which it differs in being much darker above; the red below and on the rump deeper and more brilliant; and the bill is longer. Nine males from southwest Szechwan measure: Wing, 112–119 (115.7); culmen, 17.5–19.5 (18.3) mm. The 10 females: Wing, 104.5–112.5 (109.4); culmen, 18–19 (18.4) mm. This is a considerably longer culmen than Stuart Baker gives for *Pyrrhospiza punicea punicea* from Nepal, etc. *Pyrrhospiza punicea longirostris* was described from northwestern Kansu, the only definite locality mentioned in the translation of Przewalski⁸⁹ is Gadjur, a mountain near the Tatung, northeast of Sining. Bianchi⁹⁰ confines its range to the mountains of northeastern Tibet and the Sining Mountains, eastern Nanshan (Tetung Mountains). *Pyrrhospiza punicea szetschuana* was described from southeastern Kansu and northern Szechwan, but the only definite

⁸⁹ Rowley, Ornithological Miscellany, vol. 2, p. 304, 1877.

⁹⁰ Bull. Acad. Sci. St. Petersburg, no. 6, p. 191, 1907.

locality mentioned for Szechwan is Shih-nan-n'ei-wo, near Lungan. From descriptions alone, *longirostris* and *szechuana* must be very similar. The present series was taken a long way south of the known range of *szechuana* and it may not represent the race at all, but only a direct comparison can decide; something I am unable to do at present.

The Stötzner Expedition brought back five specimens of this race from Szechwan, but Jacobi,⁹¹ who reported upon the sparrows, does not seem to have been able to make a direct comparison with *Pyrhospiza punicea* and recognizes no races at all. His measurements of the culmen of his specimens are smaller than those I obtain for the series before me.

242. *PROPYRRHULA SUBHIMACHALA INTENSIOR* Rothschild

Propyrrhula subhimachala intensior ROTHSCHILD, Bull. Brit. Orn. Club, vol. 43, p. 12, 1922 (Likiang Range, Yunnan).

One male and one female from northwest Yunnan (Fungkou, Yangtze Gorge, 6,500 feet, May; and Likiang Mountains, 10,000 feet, January–February); two females from southwest Szechwan (Mount Konka, 15,000 feet, Muli, June; Mount Gibboh, 13,000–14,000 feet, Muli, April).

243. *LOXIA CURVIROSTRA HIMALAYENSIS* Blyth

Loxia himalayensis BLYTH, Journ. Asiat. Soc. Bengal, vol. 13, p. 952, 1844 (Nepal).

Seven males, five females, and one unsexed, northwest Yunnan (Likiang Mountains, 10,000 feet, January–February; and Ndamucho, Yangtze-Mekong Divide, 14,000 feet, October); five males and three females, Barongomba, one day east of Baurong, 11,000–12,000 feet, Szechwan, no date.

Nine males measure: Wing, 85.5–90 (87.9); culmen, 15–17.5 (16.4) mm. Three females measure: Wing, 84–85.5 (84.7); culmen, 15–16.5 (16). The male and female from Ndamucho are smaller than the average in the series measured above. The male measures: Wing, 82; culmen, 15.5; the female: wing, 80; culmen, 14.5. Crossbills are known to vary considerably in size. Whether the two mentioned represent individual variation or a local race can not be decided at present with the material available.

244. *PYRRHULA ERITHACA ALTERA* Rippon

Pyrhula altera RIPPON, Bull. Brit. Orn. Club, vol. 19, p. 19, 1906 (Shayang, west Yunnan).

Three males and one female from southwest Szechwan (Mount Mitzuga, 10,000–13,000 feet, Muli, June; Zimi Valley, 15,000 feet,

⁹¹ Abh. Ber. Mus. Dresden, vol. 16, no. 1, p. 29, 1923.

west of Waerhdje, August); one male and one female, Likiang Mountains, 12,500 feet, Yunnan, January.

245. *LEUCOSTICTE WALTERI* (Hartert)

Montifringilla brandti walteri HARTERT, Die Vögel der paläarktischen Fauna, vol. 1, Heft 2, p. 138, 1904 (Sungpan, Szechwan).

Five males and seven females, Jesila (three days' trip south of Tatsienlu) 15,600–16,330 feet, May; two males and seven females, Mount Konka, 16,000–17,000 feet, June, Szechwan.

This is not a typical member of the genus *Leucosticte* Swainson. The nasal plumules are not so dense or do not cover the nostrils so thoroughly. It has the same long wing tip, emarginated tail, and other characters of the genus, however.

Hellmayr,⁹² the latest author to review the races of *Leucosticte brandti*, makes the present bird only a race of that species, but it is so much darker in every way that, it seems to me, to make it a form of that species is to obscure these great differences; the rosy margins to the rump feathers in *walteri* are much reduced.

Mount Konka seems to be the most southern locality from which the species has been reported so far. The United States National Museum also has a series from the vicinity of Tatsienlu collected by the Rev. David C. Graham. The two series are essentially alike.

246. *FRINGALAUDA NEMORICOLA NEMORICOLA* Hodgson

Fringalauda nemoricola HODGSON, Asiat. Res., vol. 19, p. 158, 1836 (Nepal).

Two males, Mount Mitzuga, 14,500 feet, Muli, June; one male and two females, Mount Konka, 16,500 feet, June; two males, Mutirong, 7,000–7,800 feet, Muli, April; three males and two females, Yulonghsi, 13,000–16,000 feet, May; one female and one unsexed, south base of the Druduron Pass, 14,500 feet, May; two females, Minya Mountains, 14,500 feet, no date; all the above localities in western Szechwan.

All have the streaked heads of the adult plumage.

247. *SPINUS AMBIGUUS* (Oustalet)

Chrysomitris ambigua OUSTALET, Bull. Mus. Paris, vol. 2, p. 186, 1896 (Yunnan).

Thirteen adults, both sexes, from northwest Yunnan (Likiang Mountains, January–February, September, October, and November); one immature male in the streaked plumage from southwest Szechwan (Noön forests, 10,500 feet, east of Muli, August).

⁹² Field Mus. Nat. Hist. Publ. 263, Zool. Ser., vol. 17, no. 3, pp. 51–57, 1929.

248. *EMBERIZA ELEGANS ELEGANTULA* Swinhee

Emberiza elegantula SWINHÖE, Proc. Zool. Soc. London, 1870, p. 134 (near Kweichow, Hupeh).

One female, Mount Gibboh, Muli, 13,000 feet, August; two males, Likiang Mountains, 11,000 feet, January; and one female, Fuchuan-shan, 10,000–12,000, Yunnan, September.

249. *EMBERIZA PUSILLA* Pallas

Emberiza pusilla PALLAS, Reise durch verschiedene Provinzen des russischen Reichs, vol. 3, p. 697, 1776 (Daurian Alps).

One male, one female, and one unsexed, Likiang Mountains, 10,000 feet, January–February; one male and one female, Weihsi, 8,000–9,000 feet, September; one male and one female, Ndamucho, Yangtze-Mekong Divide, 11,000 and 14,000 feet, October; all in Yunnan.

250. *EMBERIZA SPODOCEPHALA MELANOPS* Blyth

Emberiza melanops BLYTH, Journ. Asiat. Soc. Bengal, vol. 14, p. 554, 1845 (Tipperah, India).

One male, Weihsi, 8,000–9,000 feet, Yunnan, September.

251. *EMBERIZA FUCATA ARCUATA* Sharpe

Emberiza arcuata SHARPE, Catalogue of birds in the British Museum, vol. 12, p. 494, 1888 (Himalayas).

One male and one unsexed, Weihsi, 8,000–9,000 feet, September.

252. *EMBERIZA GODLEWSKII YUNNANENSIS* Sharpe

Emberiza yunnanensis SHARPE, Bull. Brit. Orn. Club, vol. 13, p. 12, 1902 (Gyidzin-shan, west Yunnan).

Six males, one female, and one unsexed, northwest Yunnan (Likiang Mountains, 10,000–11,000 feet, January–February, and mountains of Yungning, 12,000–13,000 feet, November–December); four males, three females, and one immature female, southwest Szechwan (Muli Mountains, 10,000 feet, May; Shouchu River, Muli, 8,500 feet, June; forests of Raronki, 12,500 feet, north of Muli, August; Mutirong, Yalung Gorge, 7,000–7,800 feet, Muli, April; Yanwekong, 10,700 feet, May).

All these belong to the dark southern race.

253. *FRINGILLA MONTIFRINGILLA* Linnaeus

Fringilla montifringilla LINNAEUS, Systema naturae, ed. 10, p. 179, 1758 (Sweden).

Four males and two females from northwest Yunnan (Likiang Mountains, 10,000 feet, January–February; mountains of Yungning, 12,000–13,000 feet, November–December).

254. PASSER RUTILANS INTENSIOR Rothschild

Passer rutilans intensior ROTHSCHILD, Bull. Brit. Orn. Club, vol. 43, p. 11, 1922
(Mekong Valley, Yunnan).

Three males and one female, Yunnan (forests of Gowa, 10,000 feet, May; Ndamucho, Yangtze-Mekong Divide, 14,000 feet, October); three males, southwest Szechwan (mountains of Djago, 10,800 feet, Muli, June; Mutirong, Yalung Gorge, 7,000-7,800 feet. Muli, April; Baurong, 7,600 feet, July).

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A CATALOGUE OF THE TROMBICULINAE, OR CHIGGER MITES, OF THE NEW WORLD, WITH NEW GENERA AND SPECIES AND A KEY TO THE GENERA

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Interest in chigger mites has been greatly increased in recent years by the discovery that they are concerned in the transmission of certain typhuslike diseases of man. This interest, although largely confined to medical men, has nevertheless so stimulated work on the taxonomy of the group that to-day there are known to science about 100 species. These are nearly all recently described and have been reported from most of the larger geographical units of the warmer regions of the world. They have been described by about a dozen scientists and in a much larger number of scientific journals, so that the time is now rather opportune for bringing together into a single paper some of the more important taxonomic data dealing with chiggers. Some of these taxonomic facts are here presented in the form of a synopsis of the known genera and others in the form of an annotated catalogue of the species of the New World. In addition, descriptions are given of 2 new genera and 11 new species.

The term "chigger mites" has been applied by the writer in the past, and is applied by him in this paper, to those acarids of the family Trombidiidae whose larvae parasitize vertebrates. The term "chigger," however, should be restricted to the larval form of a chigger mite. Rearing experiments indicate, so far as known, that all these vertebrate-infesting larvae of Trombidiidae are the young of adults that belong to the genus *Trombicula* Berlese, in the original sense in which this genus was used. The boundaries, therefore, of the subfamily Trombiculinae should be restricted to those given originally by Berlese to his collective genus *Trombicula*.

THE GENERA OF TROMBICULINAE

The writer gave a synopsis of the genera of the subfamily Trombiculinae in his Manual of External Parasites, published in June, 1929. Here it is intended to revise and extend that synopsis. Just how many of the genera of Trombidiidae, based upon larval characters, should be placed in the Trombiculinae is not known. Undoubtedly some of the unattached larvae that have been described have hosts that are vertebrates. Also it has been shown that vertebrate-infesting larvae may accidentally be resting on an invertebrate host or possibly some of them may have invertebrates as unnatural hosts.

KEY TO THE GENERA OF THE SUBFAMILY TROMBICULINAE, BASED ON LARVAL CHARACTERS

1. Dorsal plate bearing six setae, exclusive of the pseudostigmatic organs..... 2.
Dorsal plate bearing less than six setae, exclusive of the pseudostigmatic organs..... 4.
2. Four of the six setae, borne by dorsal plate, situated along its anterior margin; dorsal plate broader than long..... 3.
Only two of the six setae, borne by dorsal plate, situated along its anterior margin; dorsal plate much longer than broad; head of pseudostigmatic organs spindle-shaped..... *Schöngastiella* Hirst.
3. Dorsal plate with a median, anterior, knoblike process, but without crista..... *Leeuwenhoekia* Oudemans.
Dorsal plate without anterior process, but frequently with a crista..... *Hannemania* Oudemans.
4. Dorsal plate with five setae, exclusive of the pseudostigmatic organs; antero-median seta present; pseudostigmatic organs setiform, flagelliform, clavate, or capitate..... 5.
Dorsal plate with only four setae, exclusive of the pseudostigmatic organs; antero-median seta lacking; pseudostigmatic organs clavate..... *Walchia*, new genus.
5. Pseudostigmatic organs strongly clavate or capitate..... 6.
Pseudostigmatic organs setiform or flagelliform and frequently with barbs..... 7.
6. Chelicerae armed with a row of teeth above; palpal claw usually bifurcate..... *Schöngastia* Oudemans.
Chelicerae each with not more than one dorsal tooth; palpal claw trifurcate..... *Neoschöngastia* Ewing.
7. Each chelicera with a row of teeth above; ventral tooth may be lacking..... 8.
Each chelicera never with more than a single dorsal tooth; ventral tooth always present..... *Trombicula* Berlese.
8. Several subequal dorsal teeth present on each chelicera; dorsal plate well developed; antero-median seta pectinate. Not endoparasitic in habits..... *Odontacarus* Ewing.
Three unequal dorsal teeth on each chelicera; dorsal plate vestigial or lacking; antero-median seta simple. Living under the surface of the skin of amphibians..... *Endotrombicula*, new genus.

A CATALOGUE OF THE CHIGGER MITES OF THE NEW WORLD

In this catalogue the synonymy of various species is given where known. Representatives of some, however, have not been seen by the writer. The probable synonymy of these is indicated in the appended notes.

Family TROMBIDIIDAE

Subfamily TROMBICULINAE

Genus HANNEMANIA Oudemans

1911. *Hannemania* OUDEMANS, Ent. Ber., vol. 3, p. 137; 1912, Zool. Jahrb. Suppl. 14, Heft 1, p. 71.

HANNEMANIA ARGENTINA Lahille

1927. *Hannemania argentina* LAHILLE, Rev. Univ. Buenos Aires, vol. 24, no. 5, p. 1293, pl. 2. (The paper in which *H. argentina* is described is not in Washington libraries.)

HANNEMANIA DUNNI Sambon

1928. *Hannemania dunni* SAMBON, Ann. Trop. Med. and Parasit., vol. 22, p. 129, fig. 17.

Type host.—A salamander (*Desmognathus fuscus fuscus*).

Type locality.—"Eastern United States of America."

HANNEMANIA EDWARDSI Sambon

1928. *Hannemania edwardsi* SAMBON, Ann. Trop. Med. and Parasit., vol. 22, p. 123, figs. 10-12.

Type host.—A toad (*Bufo variegatus*).

Type locality.—Lake Nahuel Huapi, Puerto Blest, Argentine Andes.

HANNEMANIA ELTONI Sambon

1928. *Hannemania eltoni* SAMBON, Ann. Trop. Med. and Parasit., vol. 22, p. 129, fig. 16.

Type host.—A frog (*Rana sphenoccephala*).

Type locality.—San Antonio, Tex.

HANNEMANIA HOBDAIYI Sambon

1928. *Hannemania hobdayi* SAMBON, Ann. Trop. Med. and Parasit., vol. 22, p. 126, fig. 13.

Type host.—*Pleurodema bufonina*.

Type locality.—Rio Negro Territory, Argentina.

HANNEMANIA HYLAE (Ewing)

1925. *Trombicula hylae* EWING, Proc. Ent. Soc. Washington, vol. 27, p. 146;
1926, Ann. Ent. Soc. Amer., vol. 19, p. 266, figs. 1-4.

Type host.—A tree toad (*Hyla arenicolor*).

Type locality.—Cottonwood Creek, San Diego County, Calif.

The nymph and adult stages of this species have been obtained by experimental rearing.

HANNEMANIA HYLODEUS (Oudemans)

1910. *Heterothrombidium hylodeus* OUDEMANS, Ent. Ber., vol. 3, no. 54, p. 88.

1911. *Hannemania hylodeus* OUDEMANS, Ent. Ber., vol. 3, no. 58, p. 137; 1912,
Zool. Jahrb., Suppl. 14, Heft 1, p. 71, fig. 2.

Type host.—A frog (*Hylodes* sp.).

Type locality.—Brazil.

This is the type species of the genus. In it there is a well-developed crista between the pseudostigmata, a character missing from most of the species.

HANNEMANIA NEWSTEADI Sambon

1928. *Hannemania newsteadi* SAMBON, Ann. Trop. Med. and Parasit., vol. 22, p. 127, fig. 14.

Type host.—A tree frog (*Hyla rubra*).

Type locality.—Urucum, Matto Grosso, Brazil.

HANNEMANIA PATTONI Sambon

1928. *Hannemania pattoni* SAMBON, Ann. Trop. Med. and Parasit., vol. 22, p. 180, fig. 18.

Type host.—*Borborocoetes taeniatus*.

Type locality.—Temuco, Chile.

HANNEMANIA SAMBONI, new name¹

1928. *Hannemania argentina* SAMBON, Ann. Trop. Med. and Parasit., vol. 22, p. 181, fig. 19.

Type host.—*Pleurodema bibroni*.

Type locality.—Rio Negro Territory, Argentina.

HANNEMANIA STEPHENSI Sambon

1928. *Hannemania stephensi* SAMBON, Ann. Trop. Med. and Parasit., vol. 22, p. 127, fig. 15.

Type host.—A frog (*Eleutherodactylus gollmeri*).

Type locality.—Tombador, Matto Grosso, Brazil.

¹ For *H. argentina* Sambon (1928), preoccupied by *H. argentina* Lahille (1927).

Genus LEEUWENHOEKIA Oudemans

1911. *Leeuwenhoekia* OUDEMANS, Ent. Ber., vol. 3, no. 58, p. 137; 1912, Zool. Jahrb., Suppl. 14, Heft 1, p. 74.

LEEUWENHOEKIA VERDUNI (Oudemans)

1910. *Heterothrombidium verduni* OUDEMANS, Ent. Ber., vol. 3, no. 54, p. 88.
1911. *Leeuwenhoekia verduni* OUDEMANS, Ent. Ber. vol. 3, no. 58, p. 138; 1912. Zool. Jahrb., Suppl. 14, Heft 1, p. 74, fig. R.

Type host.—Opossum (*Didelphis opossum*).

Type locality.—South Brazil.

Genus NEOSCHÖNGASTIA Ewing

1929. *Neoschöngastia* EWING, Manual of external parasites, p. 187.

Species of *Neoschöngastia* differ from those of *Schöngastia* in being without the dorsal row of teeth on each chelicera. A single dorsal tooth is usually present.

NEOSCHÖNGASTIA AMERICANA (Hirst)

1921. *Schöngastia americana* HIRST, Ann. Mag. Nat. Hist., ser. 9, vol. 7, p. 37; 1922, Brit. Mus. Econ. Ser. no. 13, p. 78, fig. 45.

Type host.—Domestic fowl.

Type locality.—Dallas, Tex.

This species is a serious pest of chickens in the southern part of the United States.

NEOSCHÖNGASTIA CALIFORNICA (Ewing)

1925. *Schöngastia californica* EWING, Amer. Journ. Trop. Med., vol. 5, p. 262.

Type host.—A ground squirrel.

Type locality.—Topaz, Calif.

NEOSCHÖNGASTIA PEROMYSCHI (Ewing)

1929. *Schöngastia peromysci* EWING, Ent. News, vol. 40, p. 296.

Type host.—White-footed mouse (*Peromyscus leucopus noveboracensis*).

Type locality.—Sturbridge, Mass.

NEOSCHÖNGASTIA SCIURICOLA (Ewing)

1925. *Schöngastia sciuricola* EWING, Amer. Journ. Trop. Med., vol. 5, p. 261.

Type host.—Red squirrel (*Sciurus hudsonicus richardsonii*).

Type locality.—Florence, Mont.

NEOSCHÖNGASTIA TROUESSARTI (Oudemans)

1910. *Schöngastia trouessarti* OUDEMANS, Ent. Ber., vol. 3, no. 54, p. 87; 1912, Zool. Jahrb., Suppl. 14, Heft 1, p. 65, fig. O.

Type host.—Opossum (*Didelphis opossum*).

Type locality.—South Brazil.

Genus ODONTACARUS Ewing

1929. *Odontacarus* EWING, Manual of external parasites, p. 188.

In *Odontacarus* each chelicera is provided with a dorsal row of teeth; in *Trombicula* with a single tooth.

ODONTACARUS AUSTRALIS (Ewing)

1929. *Trombicula australis* EWING, Proc. Ent. Soc. Washington, vol. 31, p. 10.

Type host.—A lizard (*Tropidurus peruvianus*).

Type locality.—Verrugas Cañon, Lima, Peru.

ODONTACARUS DENTATUS (Ewing)

1925. *Trombicula dentata* EWING, Amer. Journ. Trop. Med., vol. 5, p. 257, fig. 3.

Type host.—White-tailed deer (*Odocoileus couesi* ?).

Type locality.—Sonora, Tex.

Genus TROMBICULA Berlese

1905. *Trombicula* BERLESE, Redia, vol. 2, p. 155 (no generic description); 1912, Redia, vol. 8, p. 83.—1915, BANKS, U. S. Dept. Agr., Office of the Secretary, Rep. 108 [Contr. from Bur. of Ent.], p. 43.

1916. *Leptotrombidium* NAGAYO, MIYAKAWA, MITAMURA, and IMAMURA, Dobuts. z. Tokyo, vol. 28, p. ?.

1925. *Neotrombicula* HIRST (subgenus), Nature, vol. 116, p. 609.

TROMBICULA ALLEEI Ewing

1926. *Trombicula alleei* EWING, Ent. News, vol. 37, p. 111.

Type host.—None.

Type locality.—Barro Colorado Island, Canal Zone.

Description based on adult form. Larva unknown.

TROMBICULA BATATAS (Linnaeus)

1758. *Acarus batatas* LINNAEUS, Systema naturae, ed. 10, vol. 1, Gen. 235, No. 22, p. 617.—1775, MÜLLER, Vollständiges Natursystem, vol. 5, pt. 2, No. 25, p. 1055.

1904. *Pattata-luis* VAN STOCKUM, Tijdschr. Kon. Nederlandsch Aardr.-kundig Gen. 1904, Verslag. Saramacca-Exp., p. 22.

1905. *Thrombidium batatas* OUDEMANS, Nova Guinea, 1903, vol. 5, p. 148.

1912. Gen.? *batatus* OUDEMANS, Zool. Jahrb., Suppl. 14, Heft 1, p. 3.

Type host.—(?)

Type locality.—Surinam.

The status of this species has not been definitely determined. It appears to be a *Trombicula* sp., and Oudemans claims it is the same as his *Microthrombidium helleri*, which is a typical *Trombicula* species.

TROMBICULA BISIGNATA Ewing

1929. *Trombicula bisignata* EWING, Ent. News, vol. 40, p. 295.

Type host.—Meadow mouse (*Microtus pennsylvanicus pennsylvanicus*).

Type locality.—Mount Katahdin, Me.

TROMBICULA BRASILIENSIS Ewing

1925. *Trombicula brasiliensis* EWING, Proc. Ent. Soc. Washington, vol. 27, p. 92.

Type host.—(?)

Type locality.—Manáos, Brazil.

TROMBICULA BRUYANTI (Oudemans)

1910. *Microthrombidium bruyanti* OUDEMANS, Ent. Ber., vol. 3, no. 54, p. 85;

1912, Zool. Jahrb., Suppl. 14, Heft 1, p. 26, fig. F.

Type host.—Opossum (*Didelphis opossum*).

Type locality.—South Brazil.

TROMBICULA COARCTATA (Berlese)

1888. *Trombidium coarctatum* BERLESE, Bull. Soc. Ent. Italiana, Ann. 20, p. 179, Tab. V, fig. 5.—1901, LEONARDI, Zool. Anz., Band 25, p. 17.

1912. *Trombicula coarctata* BERLESE, Redia, vol. 80, p. 91, fig. 42.—1921, EWING, Ann. Ent. Soc. Amer., vol. 13, p. 382, fig. 1.

Type host.—Described from adults.

Type locality.—Buenos Aires, Argentina, and Rio Apa, Paraguay.

This species has been confused by some authors with the Kedani mite, *Trombicula akamushi* (Brumpt), but it is distinct.

TROMBICULA FLUI van Thiel

1930. *Trombicula flui* VAN THIEL, Parasitology, vol. 22, p. 347, figs. 1, 2.

Type host.—Man.

Type locality.—Surinam.

This species may be a synonym of *Acarus batatas* Linnaeus.

TROMBICULA GÖLDII (Oudemans)

1910. *Microthrombidium göldii* OUDEMANS, Ent. Ber., vol. 3, no. 54, p. 84; 1912, Zool. Jahrb., Suppl. 14, Heft 1, p. 13, fig. B.

Type host.—*Dasypsecta agouti*.

Type locality.—Brazil.

TROMBICULA GUINEENSE (Bryant and Joyeux)

1913. *Microtrombidium guineense* BRUYANT and JOYEUX, Bull. Soc. Path. Exot., vol. 6, no. 3, p. 202, figs. 1-4.

Type hosts.—Domestic fowl and two monkeys (*Cercopithecus ruber* and *C. callitrichus*).

Type locality.—French Guiana.

May be a synonym of *Acarus batatas* Linnaeus.

TROMBICULA HARPERI Ewing

1928. *Trombicula harperi* EWING, Proc. Ent. Soc. Washington, vol. 30, p. 70.

Type host.—Woodland jumping mouse (*Napaeozapus insignis*).

Type locality.—Heart Lake, Essex County, N. Y.

TROMBICULA HELLERI (Oudemans)

1911. *Microthrombidium helleri* OUDEMANS, Ent. Ber., vol. 30, p. 120; 1912, Zool. Jahrb., Suppl. 14, Heft 1, p. 15, fig. C.

Type host.—A beetle (*Passalus* sp.).

Type locality.—Surinam.

According to Oudemans, this species is a synonym of the *Acarus* (*Trombicula*) *batatas* of Linnaeus. Beetles probably are not true hosts of this mite.

TROMBICULA INSULARIS Ewing

1925. *Trombicula insularis* EWING, Amer. Journ. Trop. Med., vol. 5, p. 260.

Type host.—A lizard (*Anolis cybotes*).

Type locality.—Santo Domingo.

TROMBICULA IRRITANS (Riley)

1873. *Leptus irritans* RILEY, Amer. Nat., vol. 7, p. 16.
 1877. *Tetranychus tlalsahuatl* MURRAY, Economic entomology, Aptera, p. 113.
 1886. *Leptus irritans* OSBOEN and UNDERWOOD, Can. Ent., vol. 18, p. 6.—1897, LUGGER, 2d Ann. Rep. Ent. Minnesota Exp. Sta., p. 82.
 1892. *Trombidium tlalsahuatl* DUGÈS, El Estudio, vol. 4, no. 6, p. 198, 1 pl.
 1910. *Microthrombidium alfreddugèsi* OUDEMANS, Ent. Ber., vol. 3, no. 54, p. 84.
 1911. *Microthrombidium tlalsahuatl* OUDEMANS, Ent. Ber., vol. 3, no. 57, pp. 120 and 121; 1912, Zool. Jahrb., Suppl. 14, Heft 1, p. 18, fig. D.—1913, EWING and HARTSELL, Journ. Econ. Ent., vol. 11, p. 261, fig. 10c.
 1918. "Chigger mite" HOWARD, 17th Rep. State Ent. Minnesota, p. 130, pl. 11.
 1921. *Trombicula cinnabaris* EWING, Ann. Ent. Soc. Amer., vol. 13, p. 387, fig. 3.
 1921. *Leptus* (*Trombicula*?) *similis* HIRST, Ann. Mag. Nat. Hist., ser. 9, vol. 7, p. 37; 1922, Brit. Mus. Econ. Ser. no. 13, p. 78, fig. 44.
 1923. *Trombicula tlalsahuatl* EWING, Journ. Agr. Res., vol. 26, no. 9, p. 401.
 1925. *Trombicula irritans* EWING, Proc. Biol. Soc. Washington, vol. 38, pl. 17, fig. 1; 1925, Amer. Journ. Trop. Med., vol. 5, p. 253, fig. 1.

Type host.—Man.

Type locality.—United States.

The nymphs and adults of this species have been obtained by rearing.

TROMBICULA JAPA (Ribeyro and Bambarén)

1922. *Leptus japa* RIBEYRO and BAMBARÉN, Arch. Asoc. Peruana para el Prog. Cien., vol. 2, fasc. 2, p. 115, 3 figs.

Type host.—(?)

Type locality.—Peru.

The generic status of this species is in doubt. It appears to belong to *Trombicula*.

TROMBICULA MICROTI Ewing

1928. *Trombicula microti* EWING, Proc. Ent. Soc. Washington, vol. 30, p. 80.

Type host.—Meadow mouse (*Microtus richardsoni macrops*).

Type locality.—Wyoming.

TROMBICULA MYOTIS Ewing

1929. *Trombicula myotis* EWING, Ent. News, vol. 40, p. 294.

Type host.—Little brown bat (*Myotis lucifugus lucifugus*).

Type locality.—Mount Katahdin, Me.

TROMBICULA OREGONENSIS Ewing

1929. *Trombicula oregonensis* EWING, Proc. Ent. Soc. Washington, vol. 31, p. 11.

Type host.—A mole (*Scapanus* sp.).

Type locality.—Corvallis, Oreg.

TROMBICULA PANAMENSIS Ewing

1925. *Trombicula panamensis* EWING, Amer. Journ. Trop. Med., vol. 5, p. 259.

Type host.—A cotton rat (*Sigmodon hispidus chiriquensis*).

Type locality.—Balboa, Panama.

TROMBICULA PERUVIANA Ewing

1926. *Trombicula peruviana* EWING, Ent. News, vol. 37, p. 112.

Type host.—None.

Type locality.—Peru.

Description based on adult form. Larva unknown. Species may not belong to this genus; rearing of larva will tell.

TROMBICULA SHANNONI Ewing

1929. *Trombicula shannoni* EWING, Proc. Ent. Soc. Washington, vol. 31, p. 10.

Type host.—House cat (*Felis domestica*).

Type locality.—Verrugas Cañon, Lima, Peru.

TROMBICULA SPLENDENS Ewing

1913. *Trombicula splendens* EWING, Bull. Amer. Mus. Nat. Hist., vol. 32, p. 113 pl. 7, fig. 5; 1921, Ann. Ent. Soc. Amer., vol. 13, p. 386, fig. 2.

Type host.—None (described from adult).

Type locality.—Portage, Wis.

TROMBICULA TINAMI (Oudemans)

1910. *Microthrombidium tinami* OUDEMANS, Ent. Ber., vol. 3, no. 54, p. 84; 1912, Zool. Jahrb., Suppl. 14, Heft 1, p. 24, fig. E.

Type host.—A tinamou (*Crypturus noctivagus*).

Type locality.—Brazil.

TROMBICULA THOMASI (Oudemans)

1910. *Microthrombidium thomasi* OUDEMANS, Ent. Ber., vol. 3, no. 54, p. 84; 1912, Zool. Jahrb., Suppl. 14, Heft 1, p. 28, fig. G.

Type host.—A mouse (*Akodon jelskii*).

Type locality.—Central Peru.

TROMBICULA TROPICA Ewing

1925. *Trombicula irritans* var. *tropica* EWING, Amer. Journ. Trop. Med., vol. 5, p. 258.

Type host.—A lizard (*Anadia taeniata*).

Type locality.—Chama River, Venezuela.

TROMBICULA WHARTONI Ewing

1929. *Trombicula whartoni* EWING, Ent. News, vol. 40, p. 296.

Type host.—A bird.

Type locality.—Summerville, S. C.

TROMBICULA YORKEI Sambon

1928. *Trombicula yorkei* SAMBON, Ann. Trop. Med. and Parasit., vol. 22, p. 119, fig. 6.

Type host.—A tree frog (*Hyla rubra*).

Type locality.—Urucum, Matto Grosso, Brazil.

DESCRIPTIONS OF NEW GENERA OF TROMBICULINAE

WALCHIA, new genus

Palpi rounded laterally; palpal claw trifurcate; chelicerae each with a short chela. Dorsal plate present, as long as broad; bearing only four setae, exclusive of the pseudostigmatic organs, these setae being a pair of antero-laterals and a pair of postero-laterals. Pseudostigmatic organs clavate and pectinate; eyes either lacking or represented by vestiges of a single pair. Dorsal abdominal

setae moderate in size and number, less than 50 present. Legs moderate; second pair shortest; last pair longest.

Type species.—*Trombicula glabrum* Walch.

This genus stands alone in having only four true setae on the dorsal plate. It is evidently most nearly related to *Schöngastia* Oudemans. Only the type is included. It should now be known as *Walchia glabrum* (Walch).

ENDOTROMBICULA, new genus

PLATE 3, FIGURES 1, 2

Palpi rounded laterally; palpal claw trifurcate. Chelicerae each with three dorsal teeth and one latero-ventral. Dorsal plate very poorly sclerotized, indistinct, with five setae in addition to the pseudostigmatic organs; median seta simple. Both pairs of eyes well developed, each eye having a complete cornea. Abdominal setae short, inconspicuous. Each tarsus armed distally with two simple, subequal, lateral claws and one longer, simple, and more slender middle claw. Tarsus I with a simple dorsal spine and a simple subterminal seta or spine.

Type species.—*Endotrombicula penetrans*, new species (p. 16).

Endotrombicula should come between *Hannemania* Oudemans and *Odontacarus* Ewing, being more closely related to the latter genus, from which it differs in having fewer and a definite number of dorsal teeth on the chelicerae, and a vestigial dorsal plate, as well as in a few other characters.

DESCRIPTIONS OF NEW SPECIES OF TROMBICULINAE

TROMBICULA BLARINAE, new species

PLATE 1, FIGURE 1

Palpi elbowed, having the second segment angulate laterally; first seta strongly pectinate, almost plumose; second seta shorter than the first and with several barbs; third seta with several barbs; palpal thumb small, scarcely exceeding the fourth segment; palpal claw slender and trifurcate, two accessory claws being small and situated near the apex. Chelicerae stout, sharply pointed and with minute upper tooth; lower tooth very minute or lacking. Dorsal plate more than twice as broad as long, front margin incurved between median and each fronto-lateral seta, but hind margin outwardly rounded behind each pseudostigma; all setae borne by dorsal plate strongly pectinate, postero-lateral pair longer than the others. Pseudostigmata situated about their diameter from posterior margin of dorsal plate and about as far from each other as each is from the

postero-lateral seta on its side; in front of each pseudostigma is a posteriorly concave, crescentic slit; pseudostigmatic organs minute, simple, vestigial. Eyes lacking. Dorsal abdominal setae about 36, of which 20 are arranged into two transverse rows of 10 each, all short and strongly pectinate. Legs short, last pair longest. Tarsus I with dorsal spine situated almost twice its length from base of segment and with a simple subapical seta.

Length of unengorged specimen, 0.17 mm.; width, 0.13 mm.

Type host.—Short-tailed shrew (*Blarina brevicauda*).

Type locality.—Washington, D. C.

Type slide.—U.S.N.M. No. 1018.

Described from many specimens taken from *Blarina brevicauda*, Rock Creek Park, Washington, D. C., collected by J. C. Jones, some on September 18 and some on September 20, 1929. Also from one specimen of *Peromyscus leucopus* taken at the same place by the same collector, on September 20, 1929.

TROMBICULA DUNNI, new species

PLATE 1, FIGURE 2

Palpi large, not elbowed, second segment broadly rounded on outside; first seta with two to four barbs; second seta with one barb; third seta with two to three barbs. Palpal thumb small; palpal claw usually bifurcate, with a very large, curved, inner prong and a smaller, shorter, almost straight, outer prong; traces of a smaller, inner third prong sometimes seen. Chelicerae strongly curved. Dorsal plate broader than long, front margin slightly incurved on each side of median seta, posterior margin broadly but not evenly outcurved; pseudostigmata situated far from each other and about halfway from the anterior to posterior margin of dorsal plate; pseudostigmatic organs long, slender, setiform, simple. Immediately behind each pseudostigma is an indistinct straight slit or line. Eyes double but corneas of posterior ones lacking, situated about one and a half times the diameter of the cornea of one of the anterior eyes from the lateral margins of the dorsal plate. Dorsal abdominal setae 20, arranged in irregular transverse rows as follows: I-6, II-6, III-4, IV-4. Legs medium, second pair the shortest; tarsus I with dorsal spine situated about one and a half times its length from base of segment, subapical seta about twice as long as dorsal spine.

Length of unengorged larva, 0.16 mm.; width, 0.11 mm.

Type host.—An agouti (*Dasyprocta punctata nuchalis*).

Type locality.—Chiriqui, Panama.

Type slide.—U.S.N.M. No. 1019.

Described from several specimens taken from type host, Camp Pital, Chiriqui, Panama, October 26, 1929, by L. H. Dunn and from

seven specimens taken from three young coatis (*Nasua narica panamensis*), collected at the same place by the same person.

TROMBICULA CERVULICOLA, new species

PLATE 1, FIGURE 3

Palpi stout, not angulate; first seta strongly pectinate, subplumose; second seta with three to four very long barbs; third seta with a few shorter barbs. Palpal claw tricleft, short, strongly curved; inner prong longest, outer shortest, and middle intermediate. Dorsal plate broader than long, front margin almost straight, posterior margin broadly and outwardly rounded; anterior setae subequal, shorter than the two postero-lateral setae. Pseudostigmata situated slightly behind the middle of the dorsal plate and about three times the diameter of each from each other; almost contiguous with the posterior boundary of each is a short, straight, diagonal slit; pseudostigmatic organs very long and slender, with about four or five barbs on the distal half of each. Anterior eyes well developed, each situated a little more than its diameter from the margin of the dorsal plate; posterior eyes vestigial, corneas lacking. About 26 dorsal setae present, not arranged into definite rows. Legs rather long, posterior pair longest; tarsus I with dorsal spine, spinelike and situated almost twice its length from the base of the segment; subapical seta of tarsus I spinelike.

Length of slightly engorged larva, 0.31 mm.; width, 0.22 mm.

Type host.—Barking deer (*Cervulus aureus*).

Type locality.—Muktesar, Kumaun, India.

Type slide.—U.S.N.M. No. 1020.

Three specimens at hand, all taken from type host, at type locality, March, 1930, by Mr. Cooper. This species is near *acuscutellaris* Walch, but the dorsal shield is not angulate posteriorly, and the pseudostigmatic organs have fewer barbs.

TROMBICULA PIERCEI, new species

PLATE 1, FIGURE 4

Palpi slender, not angulate laterally; first, second, and third setae long and simple; claw curved and very slender, tricleft distally with middle prong largest and lateral prongs subequal; thumb very short, subterminal. Chelicerae each with upper and lower tooth prominent. Dorsal shield indistinct but broader than long; median seta more slender than the others; postero-lateral setae longer than antero-lateral. Pseudostigmata in front of line drawn between the two postero-lateral setae and situated a little more than their diameter apart; pseudostigmatic organs very long, almost straight, and with many

barbs on distal two-thirds. Eyes subequal, both with corneas. Dorsal setae between 34 and 40. Legs long and slender, tarsus I with dorsal spine almost equal to half of segment itself, subapical seta spinelike, but smaller and shorter than dorsal spine.

Length of partly engorged larva, 0.64 mm.; width, 0.27 mm.

Type host.—A bat (*Hipposideros diadema griseus*).

Type locality.—Barrio Buyog, Municipality Sagay, Occidental Negros, Philippine Islands.

Type slide.—U.S.N.M. No. 1021.

Described from nine specimens taken from type host, at type locality, by W. D. Pierce, May 23, 1928. The characters of the palpi mark off this species very distinctly from all others.

TROMBICULA CAVICOLA, new species

PLATE 1, FIGURE 5

Palpi more moderate, subangulate laterally; first seta with many slender barbs, being subplumose; second seta subplumose; third seta shorter, but subplumose; palpal thumb stout, but longer than broad; palpal claw short, curved, and bifurcate, inner prong being much longer and stouter than outer. Ventral tooth of chelicerae sharp, dorsal tooth vestigial or lacking. Dorsal plate slightly broader than long, front margin almost straight, posterior margin broadly and evenly outcurved; setae very long; pseudostigmata behind line drawn between two postero-lateral setae and about three times the diameter of either from each other; pseudostigmatic organs long and simple. Eyes subequal, and both pairs provided with complete corneas. Dorsal abdominal setae long, straight, conspicuous, about 30 in number. Legs moderate, last pair longest; tarsus I with dorsal spine spinelike, curved and situated slightly behind the middle of the segment; subapical seta long, slender, but not surpassing claws.

Length of unengorged larva, 0.22 mm.; width, 0.14 mm.

Type host.—None. Description based on unattached larvae.

Type locality.—Reynolds Cave, Ky.

Type slide.—U.S.N.M. No. 1022.

Four larvae at hand, all being taken at type locality in 1881, by a Mr. Tucker, a collector who specialized in collecting cave insects.

NEOSCHÖNGASTIA SIGNATOR, new species

PLATE 2, FIGURE 1

Palpi conspicuous and angulate laterally along outer margin of second segment; first, second, and third setae each with many barbs, hence subplumose. Palpal thumb short, inconspicuous, not reaching to the middle of palpal claw, which is slender and trifurcate distally,

the middle prongs being the largest. Dorsal plate broader than long, slightly incurved along anterior margin and produced backward into an angle behind each pseudostigma and with a conspicuous V-shaped signature present in posterior half. Setae along the anterior margin of dorsal plate subequal and shorter than the postero-lateral setae. Pseudostigmata situated less than their diameter from the posterior margin of dorsal plate and about twice their diameter from each other; pseudostigmatic organs capitate, pedicel being about as long as diameter of head. Anterior and posterior corneas of eyes subequal, contiguous. Dorsal abdominal setae about 60, and for the most part arranged into five transverse rows. Legs moderate, last pair longest; tarsus I with dorsal spine situated its length from the base of the segment and with subapical seta moderate, somewhat spinelike, and extending slightly beyond the base of the claws.

Length of unengorged larva, 0.30 mm.; width, 0.19 mm.

Type host.—A wood rat.

Type locality.—Wilburton, Okla.

Type slide.—U.S.N.M. No. 1023.

Described from three specimens taken from type host, at type locality, by G. W. Stiles, March 17, 1929 (Bishopp, No. 8268).

NEOSCHÖNGASTIA SCELOPORI, new species

PLATE 2, FIGURES 2, 3

Palpi not angulate but rounded laterally, first and second setae long, subplumose. Palpal thumb slightly swollen and extending to middle of palpal claw; the latter strongly curved and deeply trifurcate distally, the middle prong being the longest and the other two subequal. Chelicerae strongly curved, with the upper tooth very small, sharp and procurved, and with the lower one larger, stout, and directed backward. Dorsal plate but slightly broader than long, both anterior and posterior margins being almost straight. Median seta shorter than the antero-lateral ones and these slightly shorter than the postero-lateral setae. Pseudostigmata situated slightly behind middle of dorsal plate, and far laterally, near the lateral margins of the same; in front of each is a diagonal straight line. Pseudostigmatic organs with globose heads and pedicels equal in length to the diameters of the heads. Posterior eyes smaller than anterior but with corneas. Dorsal abdominal setae about 30. Legs moderate; tarsus I peculiar in that subapical seta is situated on a conspicuous tubercle, and part of the tarsus distal to it is attenuated; dorsal spine situated almost twice its length from base to the segment.

Length of partly engorged larva, 0.57 mm.; width, 0.33 mm.

Type host.—A lizard (*Sceloporus spinosus*).

Type locality.—Uvalde, Tex.

Type slide.—U.S.N.M. No. 1024.

Four specimens at hand, all being taken from the type host, at the type locality, by F. Adams, July 13, 1928.

NEOSCHÖNGASTIA BREVIPES, new species

PLATE 2, FIGURE 4

Palpus with second segment produced into an angle laterally; first seta plumose, second and third subplumose. Palpal thumb small, short, inconspicuous; palpal claw slender, curved, trifurcate distally, the middle prong surpassing the others, which are subequal. Chelicerae strongly curved and very sharp; teeth minute to vestigial. Dorsal plate about twice as broad as long, provided with an anterior projection bearing the median seta, posteriorly not broadly rounded; median seta slightly smaller than antero-lateral setae, postero-lateral setae longest. Pseudostigmata situated slightly behind a line drawn between the bases of the two postero-lateral setae and about as far from each other as each is from the postero-lateral seta on its side. First pair of eyes situated about three times their diameter from the dorsal plate, second pair degenerate, without corneas. Dorsal setae about 50, all but 6 being arranged into five transverse rows. Legs rather short; tarsus I with dorsal spine slightly curved and situated about its length from the base of the segment, subterminal seta somewhat spikelike and situated on a broad low tubercle.

Length of unengorged larva, 0.29 mm.; width, 0.16 mm.

Type host.—White-footed mouse (*Peromyscus leucopus noveboracensis*).

Type locality.—College Park, Md.

Type slide.—U.S.N.M. No. 1025.

Sixteen specimens obtained from the type host (individuals C. P. 2, C. P. 5, and C. P. 7) by H. S. Peters and the writer, May 3, 1929. This species is closely related to *signator*, new species, but differs from it in having about 10 less dorsal setae, the posterior eye degenerate, in the shape of the dorsal plate, and in a few other characters.

ENDOTROMBICULA PENETRANS, new species

PLATE 3, FIGURES 1, 2

Palpi laterally rounded; first seta simple, second typically with two barbs, third with three barbs. Palpal claw trifurcate, middle prong much the stoutest, lateral prongs subequal, all prongs of about the same length. Palpal thumb longer than broad, not swollen, extending to middle of palpal claw. Chelicerae strongly curved and very sharp at apex, each with three sharp, recurved teeth on the upper margin and a vestigial lateral tooth near the ventral margin. Dorsal

plate indistinct, slightly sclerotized along anterior margin; median seta shortest, simple; antero-lateral setae longest. Posterior eyes smaller than anterior, both pairs with corneas; posterior eye situated its diameter from anterior eye. Pseudostigmata situated their diameter apart; pseudostigmatic organs setiform, simple, very short. Dorsal abdominal setae small, short, inconspicuous, less than 30 in number. Legs short; tarsus I with dorsal spine situated two-thirds its length from the base of the segment, but very long, extending to base of tarsal pedicel; subterminal seta moderate, somewhat spine-like, not situated on a tubercle.

Length of engorged larva, 0.46 mm.; width, 0.28 mm.

Type host.—A frog (*Arthroleptis minutus*).

Type locality.—Mount Sagalla, Kenya Colony, Africa.

Type slide.—U.S.N.M. No. 1026.

Many specimens received through Nathan Banks. Specimens taken from hosts collected by E. Heller in the year 1911 and determined by A. Loveridge. Stained sections of frog's skin show that the mites live in cavities under the growing layer of integumentary cells.

HANNEMANIA HIRSUTA, new species

PLATE 3, FIGURES 3, 5

Palpi large, stout, rounded laterally; first seta with many barbs arranged on a single side, second seta simple, third with one barb. Palpal thumb small, short, extending only to the base of palpal claw. Palpal claw bifurcate, inner prong being much stouter and considerably longer than outer. Chelicerae not strongly curved, without dorsal teeth, but each with a row of laterally projecting ventral teeth, the teeth in this row diminishing in size from apex to base of segment. Dorsal plate strongly incurved along front margin and outwardly rounded behind, being subangulate at median line; submedian setae about equal to antero-lateral ones but shorter than postero-lateral setae. Pseudostigmata slightly nearer each other than either is to the postero-lateral seta on its own side, situated along a line drawn between the postero-lateral setae; approximate to each pseudostigmata, both in front and behind, is a curved slit. Pseudostigmatic organs very long, somewhat flagelliform, and simple. Anterior and posterior eyes equally developed, contiguous, and both pairs provided with corneas. Dorsal abdominal setae very numerous, being more than 100. Legs moderate in size; tarsus I with a short dorsal spine situated over twice its length from base of segment, subapical seta extending to about the base of tarsal claws, not situated on a tubercle.

Length of partly engorged larva, 0.37 mm.; width, 0.25 mm.

Type host.—California pocket mouse (*Perognathus californicus californicus*).

Type locality.—Berkeley, Calif.

Type slide.—U.S.N.M. No. 1027.

Eight specimens at hand, received from S. B. Benson, October 1, 1929. This species differs from all other chiggers known to the writer in the form of its chelicerae and in the number of dorsal abdominal setae present.

HANNEMANIA PENETRANS, new species

PLATE 3, FIGURE 4

Palpi rounded laterally; first, second, and third setae simple, second equal to first in length, third much shorter. Palpal thumb small, inconspicuous. Palpal claw short, very sharp, trifurcate; middle prong the stoutest and longest; accessory prongs subequal. Chelicerae but slightly curved, each ending ventro-distally in a flattened spearhead, which is irregularly serrate on outer margin, basal process conspicuous and armed with three teeth on postero-dorsal aspect. Dorsal plate broader than long and posteriorly outwardly curved; submedian setae shorter than the antero-lateral, the latter shorter than the postero-lateral. Pseudostigmata situated behind a line drawn between the pair of postero-lateral setae, each about equal distance from the other pseudostigma and the postero-lateral seta on its own side; one pair of slits present, these being straight, diagonal, and situated just behind the pseudostigmata; pseudostigmatic organs short, simple. Dorsal setae about 20. Legs rather short; tarsus I with very sharp dorsal spine situated about its length from the base of the segment, subapical seta setiform, not situated on a tubercle, and extending to the base of the tarsal claws.

Length of partly engorged specimen, 0.81 mm.; width, 0.49 mm.

Type host.—Leopard frog (*Rana pipiens*).

Type locality.—Great Falls of Potomac, Va.

Type slide.—U.S.N.M. No. 1028.

Described from eight specimens; two taken from a green frog (*Rana clamitans*), collected at the type locality September 21, 1926, by the writer; four taken from leopard frogs (*Rana pipiens*), at type locality, August 27, 1930, by H. E. and Paul Ewing; and two from same host and locality, September 24, 1930, by same collectors. This species is nearest to *H. eltoni* Sambon but has the palpal claw trifurcate and short pseudostigmatic organs.

EXPLANATION OF PLATES

(Drawings by Eleanor A. Carlin)

PLATE 1

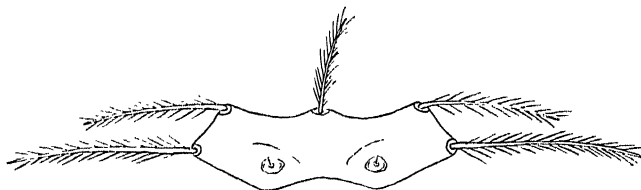
- FIGURE 1. *Trombicula blarinae*, new species; dorsal plate.
2. *Trombicula dunni*, new species; dorsal plate and eyes.
3. *Trombicula cervulicola*, new species; dorsal plate and eyes.
4. *Trombicula piercei*, new species; central view of palpus.
5. *Trombicula cavicola*, new species, palpal claw from below.

PLATE 2

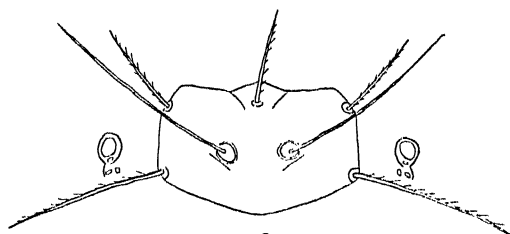
- FIGURE 1. *Neoschöngastia signator*, new species; dorsal view.
2. *Neoschöngastia scelopori*, new species; lateral view of chelicera.
3. *Neoschöngastia scelopori*, new species; side view of tarsus I.
4. *Neoschöngastia brevipes*, new species; dorsal plate and eyes.

PLATE 3

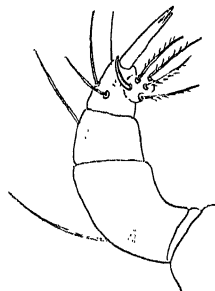
- FIGURE 1. *Endotrombicula penetrans*, new species; outer view of chelicera.
2. *Endotrombicula penetrans*, new species; dorsal view of cephalothorax.
3. *Hannemania hirsuta*, new species; ventral view of chelicera.
4. *Hannemania penetrans*, new species; lateral view of chelicera.
5. *Hannemania hirsuta*, new species; dorsal plate and eyes.



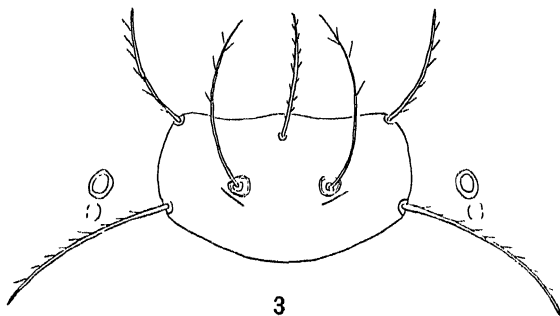
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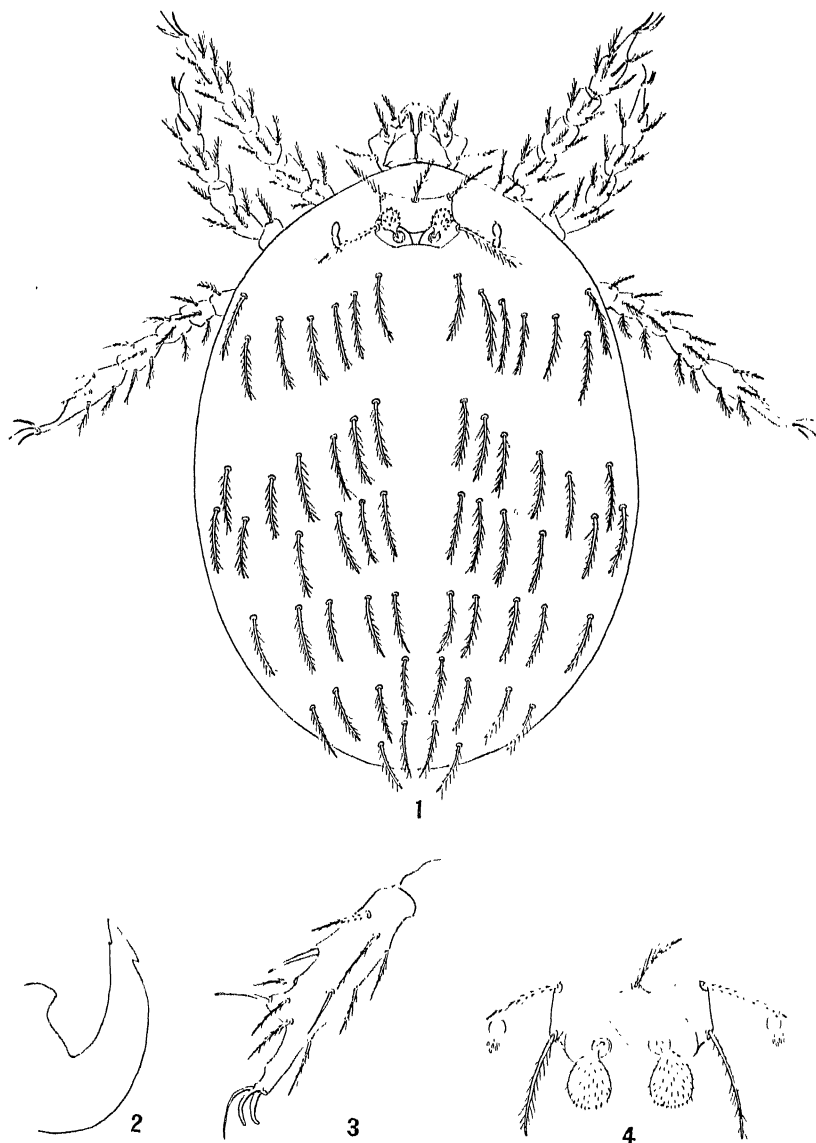


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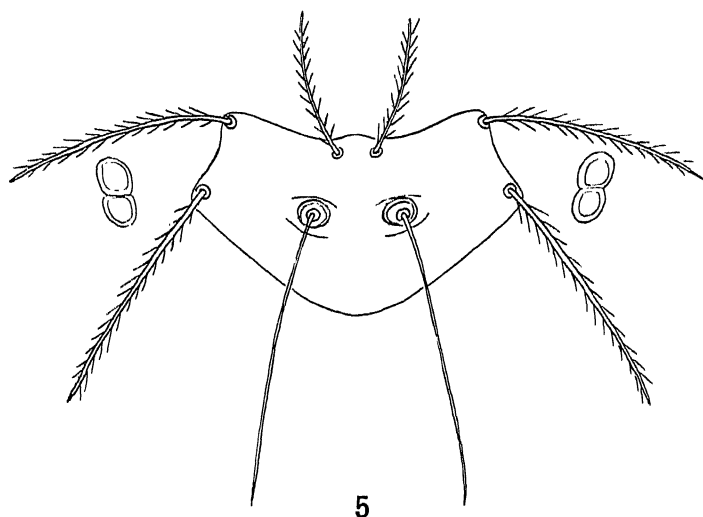
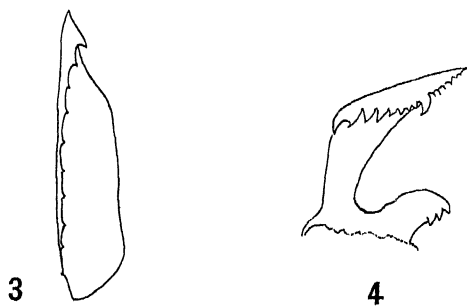
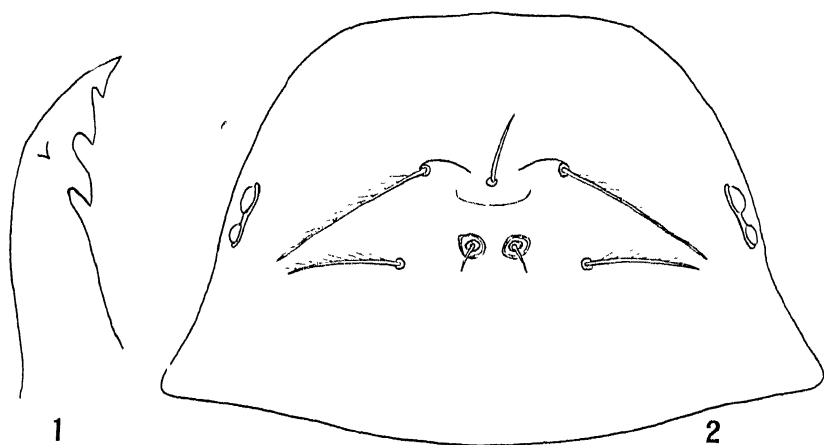
5

NEW SPECIES OF *TROMBICULA* BERLESE
FOR EXPLANATION OF PLATE SEE PAGE 19.

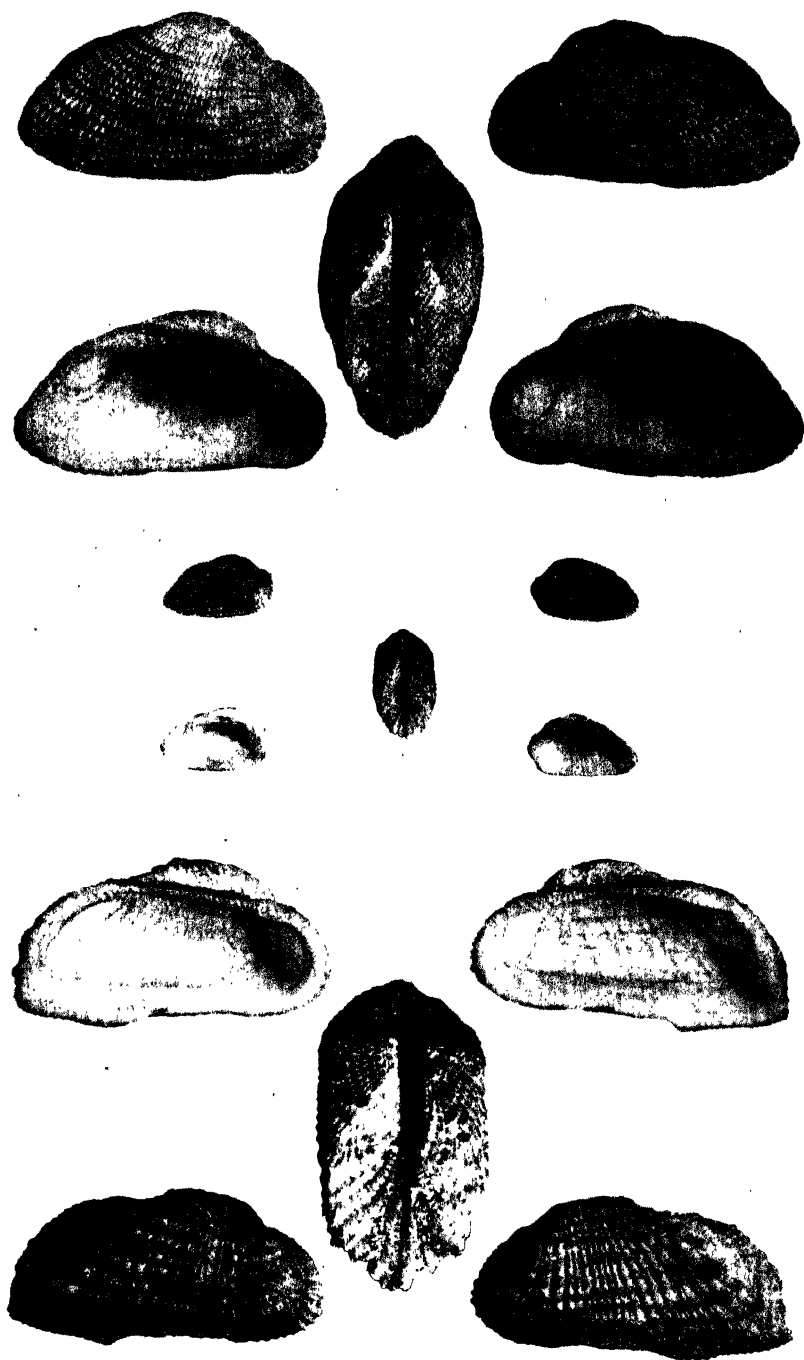


NEW SPECIES OF NEOSCHÖNGASTIA EWING

FOR EXPLANATION OF PLATE SEE PAGE 19.



ENDOTROMBICULA PENETRANS, NEW GENUS AND SPECIES, AND NEW
SPECIES OF HANNEMANIA OUDEMANS
FOR EXPLANATION OF PLATE SEE PAGE 19



MOLLUSKS OF THE GENUS ACAR

Five top figures, *Acar gradata*; five middle figures, *A. bailyi*, new species; five bottom figures, *A. panamensis* new species.

THE WEST AMERICAN MOLLUSKS OF THE GENUS ACAR

By PAUL BARTSCH

Curator, Division of Mollusks and Cenozoic Invertebrates, United States National Museum

A recent inquiry by Prof. Joshua L. Baily, who is revising Keep's "West Coast Shells," regarding the status of *Arca gradata* in California made it necessary to subject the members of this group to a critical examination; the results thereof are noted herein. The change of concept here expressed is due in part to the splendid series of specimens that we secured on the cruise of the United States Bureau of Fisheries steamer *Albatross* in its explorations of the waters of Lower California and the Gulf of California in 1911 and in part to the contributions of many correspondents, both in the United States and in the regions to the south, that have enriched the collection of the National Museum sufficiently to clear up some doubtful problems.

First of all, I believe that *Acar*, which was proposed by Dr. J. E. Gray in 1857¹ as a subdivision of the genus *Barbatia*, is entitled to generic rank. The curiously elevated smooth muscle scars combined with the peculiar shape and sculpture make it a compact unit group, rather widely distributed in warm waters.

Gray, in defining *Acar* (loc. cit.), mentions three species, namely, *Byssosarca reticulata*, *B. divaricata*, and *B. gradata*, without designating a type. A type designation seems not to have been made until 1925, when Dr. Wendell P. Woodring² selected *Arca gradata*: Broderip and Sowerby for that purpose.

The genus *Acar* in the east Pacific ranges from southern California to Peru, where it is represented by a number of species whose distribution coincides quite well with the faunal areas as at present conceived.

¹ Ann. Mag. Nat. Hist., ser. 2, vol. 19, p. 369, 1857.

² Miocene mollusks from Bowden, Jamaica, pt. 1, Carnegie Inst. Washington Publ. no. 366, p. 36, 1925.

ACAR BAILLYI, new species

PLATE 1, five central figures

Shell small, rhomboidal, rather inflated, white, with a buffy tinge. The tips of the umbones are at the posterior extremity of the anterior fourth of the shell. The umbones are strongly curved and separated only by a narrow space. The cardinal area is narrow and marked by a few slender incised lines, which parallel the hinge margin. The anterior margin of the shell is well rounded. The posterior margin is less strongly rounded and somewhat produced at the junction of the posterior and ventral border. The sculpture of the exterior consists of numerous radiating cords, of which 9 occur on the anterior portion and 13 upon the posterior part, while 23 are present on the middle. In addition to the radiating cords, which increase in strength from the umbone toward the ventral margin, the valves are marked by concentric lamina, which render the cords tuberculated. The anterior ventral and posterior borders of the valves are rendered wavy by the external sculpture at the edge. The interior of the shell is white with a buffy tinge, particularly so in the umbonal region. The muscle scars are large, smooth, and decidedly elevated. The teeth of the hinge are few, 8 being present in the anterior group, which slope anteriorly, and 10 in the posterior group, which slope posteriorly. The central of these tooth groups are mere dots, and they increase in size in both directions as shown in our figure.

Type.—U.S.N.M. No. 382474 is an adult specimen collected by A. M. Strong under stones at Balboa, Calif. It measures: Length, 8.8 mm.; height, 4.9 mm.; diameter, 4.5 mm. U.S.N.M. No. 347810 contains 48 topotypes received from the same source; U.S.N.M. No. 74831 contains 11 specimens from San Diego, Calif., from the Stearns collection, and U.S.N.M. No. 74830 contains 3 specimens from San Diego, collected by Henry Hemphill; U.S.N.M. No. 63302 contains 4 specimens collected by Doctor Dall; U.S.N.M. No. 127242 contains 2 specimens collected by Mrs. Oldroyd.

Remarks.—This species was named in our collection *Arca gradata* Broderip and Sowerby, and *Fossularca solida* Sowerby. From the first it can at once be distinguished by its size. A glance at our figure will also give other distinguishing characters, and from *Fossularca solida* Sowerby by its entirely different ligamental structure.

ACAR GRADATA (Broderip and Sowerby)

PLATE 1, five top figures

1829. *Arca gradata* BRODERIP and SOWERBY, Zool. Journ., no. 15, pp. 365-366.

Shell moderately large, white with yellowish tinge, rhomboidal with the umbones about opposite the anterior third of the shell.

The umbones are fairly closely approximated and leave only a narrow marginal area between them, which is marked by a few fine lines paralleling the margin of the hinge. The anterior end is strongly rounded and the posterior somewhat produced ventrally. The surface of the shell is marked by radiating, closely approximated, slender cords, of which at least 15 are present on the anterior end and 21 on the posterior area, and 48 in the middle part. In addition to these cords the valves are marked by concentric lamina, which render the cords nodulose. The sculpture is best visualized by consulting our figures. Interior of shell white, with a buffy tinge. The anterior, posterior, and ventral margins are rendered denticulated by the external sculpture. The hinge teeth are small in the center and increase in size toward either extremity, becoming somewhat irregular toward the extremities. In the main the anterior slope anteriorly and the posterior posteriorly, but the early posterior teeth have a somewhat triangular shape, while the anterior ones are somewhat irregular. Both of them increase in size from the median portion outward. Fourteen appear to be present both in the anterior and posterior half of the hinge in the specimen figured. The muscle scars are large, smooth, and strongly elevated.

We have many specimens of this species, which seems to range through the entire Mazatlanic faunal area, and also appears to extend up on the outer coast of Lower California to Point Abrejos. The specimen that I have figured is one of a small series from Mazatlán, the type locality.

Type.—U.S.N.M. No. 382428. It measures: Length, 23.8 mm.; height, 12.7 mm.; diameter, 12.6 mm.

Remarks.—Sowerby says that "this elaborately ornamented shell looks at first sight like a piece of Chinese carving. From Mazatlán."

This species resembles most nearly the Panama forms as far as size is concerned. It differs from them, however, in having the sculpture much finer in every way.

ACAR PANAMENSIS, new species

PLATE 1, five bottom figures

Shell moderately large, rather inflated, white with a buffy tinge, strongly rounded anteriorly, somewhat produced at the posterior ventral margin. The umbones are well approximated, leaving only a narrow cardinal area, which is marked by incised lines parallel to the margin of the hinge. The exterior of the valves is marked by strong radiating cords, of which 11 are present on the anterior part, 15 on the posterior part, and 39 in the middle portion. The posterior part forms a decided angle where it passes into the sides. The anterior and posterior borders of the valves are rendered finely denticu-

lated by the external sculpture; the ventral margin a little less so. The hinge teeth increase in size from the center, both anteriorly and posteriorly, and promptly bend anteriorly in the anterior portion and posteriorly in the posterior portion. There are 12 teeth in the anterior and 18 in the posterior half; they increase in strength from the center outward. The muscle scars are very prominent, smooth, and elevated.

Type.—U.S.N.M. No. 74827, the specimen figured, comes from Panama, and measures: Length, 24.2 mm.; height, 12.2 mm.; diameter, 13.4 mm.

Remarks.—This species may be the shell figured by Reeve on Plate 14, figure 92, of his *Conchologia Iconica* in 1844. He says it was collected by Cuming, who found it attached to stones at St. Elena, West Colombia (Ecuador). The figure certainly resembles our species, which is easily distinguished from the Mazatlanic shell by its much coarser sculpture.

In addition to the above, our collection contains other specimens from Panama, the Galapagos Islands, and one valve from Manta, Ecuador.

NOTES ON FRANCIS WALKER'S TYPES OF NORTH AMERICAN FLIES OF THE FAMILY TACHINIDAE

By J. M. ALDRICH

Associate Curator, Division of Insects, United States National Museum

The well-known British entomologist Francis Walker described numerous North American flies of the family Tachinidae in two publications: List of the Specimens of Dipterous Insects in the Collection of the British Museum, part 4, 1849; and Insecta Saundersiana, or Characters of Undescribed Insects in the Collection of William Wilson Saunders, Esq., 1852.

At that early time but little was known of the classification of the group, and Walker's descriptions were poor, even for the period. The first attempt to place his species in more restricted genera was by Osten Sacken, in his Catalogue of North American Diptera (Smithsonian Institution, 1878). Osten Sacken had the advantage of having examined many of the types in the British Museum, where Walker's were all deposited. He was not a specialist in the group, and but little advance in its classification had been made since the time of Walker, except in the works of Rondani and Schiner, which pertained only to the European members, with a few exceptions on the part of Rondani.

The first serious attempt to identify Walker's North American species was by Coquillett, in his Revision of the Tachinidae of America North of Mexico (Technical Series No. 7, Division of Entomology, United States Department of Agriculture, 1897). Coquillett had not seen Walker's types, but he studied the descriptions very carefully and believed that he had identified most of them. The nomenclature that he accepted has been adopted quite generally since that time, at least as to the species, although Townsend in various papers expressed the opinion that Coquillett had misidentified many of them.

Maj. E. E. Austen reported the results of an examination of many of Walker's types in Annals and Magazine of Natural History, ser. 7, vol. 19, pp. 326-347, 1907.

In 1929 I had the opportunity to examine most of Walker's type specimens, although in the time at my disposal I did not see all of them. The object of the present paper is to report the results of this work and to indicate as far as possible the available names of the species Coquillett had before him, in those cases where he erred in his identification of Walker. Species of which I did not see the types are also included, with such explanations as I can offer from the much larger collections now available and the advances in classification that have been made in recent decades. They are listed under Walker's names, and in the order of Coquillett's work, although in this arrangement I am obliged to begin with a series in which I did not see the types.

I am under obligation to the authorities of the British Museum, especially to Maj. E. E. Austen, D. S. O., keeper of the division of insects, for the privilege of examining this important material.

Only species from the region north of Mexico are here discussed.

Gymnosoma par WALKER, List, p. 692. Coquillett (p. 43) made this a synonym of *G. fuliginosa* Robineau-Desvoidy. Type not seen. The genus is a striking one, and but one species is known from the Eastern States; no one has questioned the correctness of Coquillett's identification.

Gymnosoma occidua WALKER, List, p. 692. Coquillett (p. 43) placed this as a synonym of *Cistogaster immaculata* Macquart. Townsend¹ discussed *immaculata* and thought he could make out a division of the abundant material into two forms, but left *occidua* as a synonym of *immaculata* as it had been placed by Coquillett. Later² he decided that *occidua* is the valid name for one of the forms, *immaculata* for the other. He took up the subject again in his Taxonomy of the Muscoidean Flies,³ where he redescribed *occidua* in both sexes and referred it to the genus *Gymnocyrtia* Brauer and Bergenstamm. The type of the genus is *divisa* Loew, the only included species, which is believed to be a synonym of *occidua*. The generic characters are slight, and there is room for difference of opinion as to whether it is not a synonym of *Cistogaster*. The genotype of the latter is the European *globosa* Fabricius, which has the petiole of the apical cell ending in the exact tip of the wing, and also has a less protuberant oral margin. Walker's description of the abdomen seems ample to fix the form he had. I did not see his type.

Hyalomyia occidentis WALKER, Insecta Saundersiana, p. 260. The description is less than five lines long. I did not see the type. Coquillett (p. 44) believed he had recognized the species and referred

¹ Trans. Amer. Ent. Soc., vol. 22, p. 66, 1895.

² Ann. Mag. Nat. Hist., ser. 6, vol. 19, p. 31, 1897.

³ Smithsonian Misc. Coll., vol. 51, p. 127, 1908.

it to *Phoranthia*, with several supposed synonyms. He mentioned 12 localities and probably included at least 25 specimens, including a type of *Hyalomyia aldrichi* Townsend. His series has been rearranged and mixed with other material in the attempt to make out the various forms included as synonyms and some specimens have apparently been used in exchange. Townsend⁴ separated one specimen as type of *Phoranthella morrisoni*, new genus and species, but it remains totally undescribed. Robertson⁵ expressed the view that Coquillett included at least three species and that *occidentis* can not be recognized from the description. Without publishing on the matter, Townsend later separated a female unlike Coquillett's from Los Angeles County, Calif., and labeled it as *occidentis* "typical."

It may be assumed that Coquillett misidentified *occidentis*, as his specimens do not agree with Walker's statement, "Abdomen hoary, black toward the base and with two black bands," especially as to the black bands. If we leave the true *occidentis* aside until the type is seen, the question of the identity of Coquillett's species remains for consideration. He undoubtedly included *aldrichi*, and this name is the valid one for most of his specimens; some of his other synonyms may be distinct species. The genus should be *Hyalomyia*, as first given by Townsend. *H. aldrichi* is a widespread species, with the first abdominal segment black, all the following with glistening white pollen and with indications of a median black stripe.

Trichopoda histrio WALKER, List, p. 697. No locality, but the type must have been from tropical America; I did not see it. Coquillett (p. 48) made it a synonym of *plumipes* Fabricius. Townsend published notes on the group in Taxonomy of the Muscoidean Flies,⁶ in which he seemed to show *histrio* as a distinct form in his genus *Polistomyia*; but in his later work on the National Museum collection he apparently gave this up, as he left no specimens labeled with Walker's name. As to the status of *Polistomyia*, it is obvious from the specimens labeled by Townsend that the apical cell has a very short petiole and the hind tibiae are strongly ciliate, in the type species *trifasciata* Loew; other characters are very slight, hence I do not accept the genus, and should call the species *Trichiopoda plumipes* Fabricius, as Coquillett did, merely amending the spelling of the genus to agree with its original form.

Phyto clesides WALKER, List, p. 757. Coquillett (p. 51) identified this as a species that he had described two years before⁷ as *Phyto setosa*. Austen⁸ stated that Walker's type belongs to the genus *Phorichaeta* Rondani, a genus that has been regarded by later Euro-

⁴ Proc. Biol. Soc. Washington, vol. 28, p. 23, 1915.

⁵ Can. Ent., vol. 33, p. 285, 1901.

⁶ Smithsonian Misc. Coll., vol. 51, p. 134, 1903.

⁷ Journ. New York Ent. Soc., vol. 3, p. 99, 1895.

⁸ Ann. Mag. Nat. Hist., ser. 7, vol. 19, p. 336, 1897.

pean authors as a synonym of *Wagneria* Robineau-Desvoidy. On examining the type I at first agreed with this disposition of it, but further examination showed that it belongs to *Eutrichogena* Townsend.⁹ It is, in fact, the species on which Townsend based the genus, *Trichogena setipennis* Coquillett, which becomes a synonym. Townsend¹⁰ had stated that *Neophorichaeta johnsoni* Smith is a synonym of *setipennis*, a conclusion later accepted by Smith. There is no doubt of the validity of *Eutrichogena*; hence Walker's species should be called *Eutrichogena clesides*. Meanwhile Townsend¹¹ had proposed the new genus *Neophyto* for Coquillett's *setosa*, which is not a *Phyto*. This has been generally accepted for years; Coquillett's species is therefore *Neophyto setosa*. It has no postscutellum, and I think it belongs to the family Sarcophagidae.

Tachina theutis WALKER, List, p. 778. Coquillett (p. 52) placed this in its proper genus, *Cryptomeigenia* Brauer and Bergenstamm. I took full notes on the type, a male from Nova Scotia. The genus contains several North American species, which show modifications of the ovipositor in the female available for specific distinction in at least a part of the series. A revision of the genus is now in progress and will probably be published shortly after the present paper; hence it is not desirable to discuss the specific characters here.

Tachina prisca WALKER, List, p. 780. Coquillett (p. 52) placed this as a synonym of the preceding, and it certainly belongs to the same genus. The type is a female from Nova Scotia, different from *theutis*, on which I took notes that will be used in the forthcoming work just mentioned.

Tachina convecta WALKER, Insecta Saundersiana, p. 276. Walker had already, page 264, established the genus *Schizotachina* for this and his *Tachina exul*, immediately following it. Coquillett (p. 55) made *exul* a synonym of *convector*, which was a very natural course, as the descriptions are almost exactly the same. Both were from "United States." I was surprised on examining the type of *convector* to find that it did not match the specimens I had with me. My notes run:

One male, United States. It is in good condition as to antennae and abdomen. I note first an absence of the interruptions of the basal silvery bands on second and third abdominal segments. The band seems entire on the second and only interrupted in the middle on the third; although narrow in a certain light, they are not so sharply limited as in my two males. The band is indistinct on the fourth segment laterally, perhaps on account of condition. The discal row of bristles on the fourth segment is distinctly behind the middle; not so in mine. The narrowest part of the parafacial is much wider than in my males, and the bristles of the facial ridges are only four, on lowest one-third or two-sevenths. Wings a little milky.

⁹ Proc. Biol. Soc. Washington, vol. 28, p. 23, 1915.

¹⁰ Insector Insidae Menstruus, vol. 3, p. 116, 1915.

¹¹ Smithsonian Misc. Coll., vol. 51, p. 55, 1908.

The specimens I had with me had the narrow basal silvery bands of the second, third, and fourth abdominal segments three times interrupted; in other words, a row of four silvery spots, the outer wider than the inner. This is the species referred to by Townsend when he says¹² that *Clausicella usitata* Coquillett (p. 56) and *Neaera longicornis* Coquillett¹³ are synonyms of *convecta*. The discovery that there are two species of *Schizotachina* would seem to indicate *usitata* for the name of the second, but I have found a peculiar complication here. Coquillett described *usitata* from three males and four females, collected in the White Mountains, N. H. (Morrison), and at New Bedford, Mass. (Hough). Later he decided that there were two species and removed those from the White Mountains, leaving only a female from New Bedford under the species label. Townsend's note on synonymy was based on this female, and he apparently knew nothing of the whereabouts of the males. I have had the good fortune to find the three males, and they belong to a species not named in our collection, which I place provisionally in the genus *Plectops*. Since no one has published anything about the occurrence of two species under the name *usitata*, it remains to decide which shall bear the name. I therefore designate the males as the true *usitata*, letting the female go into *longicornis*. This course preserves all the names, while the designation of the female would leave us with two names for one species and none for the other. The effect of this designation is to leave *Schizotachina longicornis* Coquillett as the valid name for the second species of the genus, differing from *convecta* in having the basal abdominal bands three times interrupted, in having much narrower parafacials in the male, and in being decidedly smaller.

Coquillett had three specimens that he called *convecta*; one from Horse Neck Beach, Mass., has no abdomen, but is probably the true *convecta*; while the other two, from Waco, Tex., and Colorado, are *longicornis*.

Tachina exul WALKER, *Insecta Saundersiana*, p. 277. See note under preceding. Unfortunately I have no note on the type. There is very slight doubt that it is a synonym of *convecta*, as the two descriptions are so nearly identical. Walker thought the specimen a female, but as it has the third antennal joint divided it was certainly a male.

Dexia pedestris WALKER, *Insecta Saundersiana*, p. 313. Placed in *Hypostena* by Coquillett (p. 51). The type is a male of the genus *Cryptomeigenia*, and is the same species as Walker's *Tachina demylus*, 1849.

¹² Ent. News, vol. 26, p. 366, 1915.

¹³ Proc. U. S. Nat. Mus., vol. 25, p. 106, 1902.

The species identified as *pedestris* by Coquillett was described by Townsend as *Meigenielloides cinerea*.¹⁴ As Townsend did not connect his species with that of Coquillett, I failed to observe that they were the same, and redescribed it as *Synoris coquilletti*.¹⁵ No other species of the genus is known.

Dexia pristis WALKER, List, p. 841. Coquillett (p. 64) placed the species in *Macquartia*, following an identification by Brauer and Bergenstamm. Before seeing the type I had accepted Coquillett's identification of the species, but had removed it from *Macquartia* to the genus *Pseudevantha*, which Townsend¹⁶ had erected for *linellii*, new, from Mexico. An examination of the type showed that Coquillett had identified it correctly. Brauer and Bergenstamm erred, however, in the genus to which they assigned the specimen sent them for identification. Townsend did not accept Coquillett's species as the true *pristis*; in 1892 he had described it as *Aporia limacodis*, and he later¹⁷ made this the type of the new genus *Anaporia*. This genus I do not consider distinct from *Pseudevantha*.

Tachina areos WALKER, List, p. 766. Placed in *Polidea* by Coquillett (p. 64), a genus now regarded as synonymous with *Lydina* Robineau-Desvoidy. Townsend had in 1892 described *Tryphera americana*, *T. polidoides*, and *Polidea americana* in a single paper¹⁸; all these Coquillett placed as synonyms of *areos*. In my Catalogue of North American Diptera,¹⁹ I separated *Tryphera americana* Townsend as a distinct species of *Polidea*, from an examination of the type.

As I did not see Walker's type, and as the large collection available for study shows much variation among the specimens, I can at present only indicate the nature of the problem here. There appears to be in Europe only one species of *Lydina*, the genotype, *aenea* Meigen. It differs from the common form in this country most obviously in having black palpi. I had regarded this as a sufficient distinction for *areos* until obliged to review the matter for the present paper. I now find that Walker stated that *areos* has "palpi black." There is now in the National Museum a series of five males and three females of *Lydina*, collected by me at Hammond, Ill., June 24, 1915, all of which have black palpi; there is also a female from Viola, Idaho, collected by me. A male and a female of *aenea* from Italy (Bezzi) show some differences, but hardly more than our series shows within itself. If the black palpi are specific, and our specimens with that character belong to *aenea*, then Walker's *areos* is probably a synonym,

¹⁴ Proc. U. S. Nat. Mus., vol. 56, p. 574, 1919.

¹⁵ Proc. U. S. Nat. Mus., vol. 69, art. 22, p. 12, 1926.

¹⁶ Proc. U. S. Nat. Mus., vol. 49, p. 416, 1915.

¹⁷ Proc. U. S. Nat. Mus., vol. 56, p. 560, 1919.

¹⁸ Can. Ent., vol. 24, pp. 78, 79, and 82, respectively, 1892.

¹⁹ Smithsonian Misc. Coll., vol. 46, no. 1444, p. 436, 1905.

and one of Townsend's names will apply to the species with yellow palpi. With only a single pair from Europe I am in doubt. We have 42 specimens of *Lydina* from North America, and they show remarkable variations in antennal form and in the degree of hypertrophy of the front tarsi in the females. It would not be feasible to attempt a further analysis here.

Tachina masuria WALKER, List, p. 753. Coquillett (p. 72) identified this as the species that he had previously described²⁰ as *Olytiomyia exilis*, making it the type of a new genus, *Eutrixa*. Austen²¹ published the following note on Walker's type: "Is an *Acemyia*, Rob.-Desv., apparently distinct from *A. dentata* Coq. and *A. tibialis* Coq." As I did not see the type, I can add nothing to this. Coquillett's species is easily disposed of by reviving his *exilis*, which is not a synonym; for some years it has been correctly known as *Eutrixa exilis* Coquillett.

Tachina corythus WALKER, List, p. 797. Coquillett (p. 73) placed it as a synonym of *Xanthomelana atripennis* Say. The descriptions agree very well, and no one has proposed a different disposition of *corythus*. I did not see the type.

Tachina aelops WALKER, List, p. 796. Coquillett (p. 73) placed this in the genus *Beskia* Brauer and Bergenstamm, which was erected for a new species named *cornuta*, from Brazil. Coquillett placed *cornuta* as a synonym of *aelops*, and I²² agreed with this on examining the type of *cornuta*, but without seeing the type of *aelops*. Austen²³ referred Walker's type to *Beskia*. Townsend²⁴ still thinks the two species distinct; this, however, does not interfere with the correctness of the name used by Coquillett, *Beskia aelops* Walker, as he refers the species to that genus. I did not see Walker's type.

Tachina insolita WALKER, Insecta Saundersiana, p. 277. Coquillett (p. 85) placed this in the genus *Melanophrys*, along with the type species of the genus, *flavipennis* Williston. Later²⁵ he placed *flavipennis* as a synonym of *insolita*. The specimen now bearing his label as *insolita* is correctly named, but his specimen now bearing the name *flavipennis* is also *insolita*. He attempted to separate the two species by the abdominal bristles, which are somewhat variable and do not lend themselves to the purpose. In *insolita* the third antennal joint is hardly longer than the second; in *flavipennis* it is fully twice as long in the female and even longer in the male. The male of *insolita* has a striking, thick median

²⁰ Journ. New York Ent. Soc., vol. 3, p. 53, 1895.

²¹ Ann. Mag. Hist., ser. 7, vol. 19, p. 366, 1907.

²² Ann. Ent. Soc. Amer., vol. 18, p. 120, 1925.

²³ Ann. Mag. Nat. Hist., ser. 7, vol. 19, p. 345, 1907.

²⁴ Ent. News, vol. 39, p. 150, 1928.

²⁵ Proc. U. S. Nat. Mus., vol. 37, p. 587, 1910.

horn projecting downward on the second genital segment, and the parafrontal and parafacial are smoothly silvery down to the large brownish "transverse impression" near the vibrissae; the male of *flavipennis* has no horn on the genital segment, and the parafrontal and parafacial are shining black, except a narrow silvery band extending from the eye to the suture at the level of the second antennal joint. The female of *flavipennis* has a silvery pollinose stripe from eye to antenna about as in its male, while that of *insolita* has a more diffuse, wider stripe beginning higher up at the eye and sloping downward as it approaches the antenna—it also has a rather faint spot of pale pollen on the parafacial resting against the eye at its lower curve. In both sexes, *flavipennis* has a clump of bristles at the vibrissa, while *insolita* has only one row.

I examined the type of *insolita*; it is a female with characters as indicated. Coquillett had the species, but erred in trying to make two of it. I have also examined the types of *flavipennis* in the University of Kansas.

Townsend²⁶ described *Atropharista jurinoides*, new genus and new species, which is a synonym of *Melanophrys insolita*, as pointed out by Coquillett, Townsend himself²⁷ having admitted the synonymy of the species.

Ocyptera dotadas WALKER, List, p. 694. Coquillett (p. 86) placed this as a synonym of *Ocyptera carolinae* Robineau-Desvoidy. The type, according to my notes, is "one male, a fragile and damaged specimen that I dare not spread." It is from Jamaica. In my revision of the genus, to which I applied the prior name *Cylindromyia*,²⁸ I placed both *dotadas* and *carolinae* among the unidentified species.

Walker's description states that the antennae are shorter than in the European forms; the abdomen is red, with base and tip black. These are the only characters given that seem of value in identifying the species. Perhaps specimens from Jamaica may ultimately justify a specific determination.

Ocyptera epytus WALKER, List, p. 694. Coquillett (p. 86) placed this as a synonym of *carolinae* Robineau-Desvoidy. I did not find the type in the British Museum. Townsend²⁹ expressed the opinion that it is the same species as *euchenor*, but he made out the synonymy only from the description, and his *euchenor* was not the same as Walker's. I listed *epytus* as unidentified in my revision, noted under the preceding species. It was described from Georgia.

Ocyptera euchenor WALKER, List, p. 696. Coquillett (p. 86) placed this with the two preceding as synonyms of *carolinae* Robineau-Desvoidy. In my revision of the genus, noted above, I

²⁶ Trans. Amer. Ent. Soc., vol. 19, p. 92, 1892.

²⁷ Trans. Amer. Ent. Soc., vol. 22, p. 72, 1895.

²⁸ Proc. U. S. Nat. Mus., vol. 68, art. 23, p. 26, 1926.

²⁹ Journ. New York Ent. Soc., vol. 5, p. 177, 1897.

placed the species by the aid of Major Austen, to whom I sent my manuscript key and some numbered specimens before publishing. The type, which I have since seen, is a female and agrees with the species accepted by me. The supposed *euchenor* of Townsend³⁰ is *vulgaris*, new species of my revision.

Ocyptera dosiades WALKER, List, p. 695. Coquillett (p. 86) identified this correctly. The type is a female. Major Austen had assisted me in placing it in my revision before I saw the type. I refer it to the genus *Cylindromyia*, like the others.

Tachina ampelus WALKER, List, p. 732. Coquillett (p. 88) placed the species as a synonym of *Panzeria radicum* Fabricius. Later, however, he separated specimens under the name *ampelus*, which agree with the type, as I found by sending some to Major Austen for comparison. I failed to see the type myself, but there are good external characters. Tothill³¹ revised the genus and adopted *Ernestia* as the proper generic name, redescribing *ampelus* (p. 273). It is a very common species. Coquillett apparently identified the species correctly in 1897, but erred in making it a synonym of a European species not now believed to occur in North America.

Curran³² has proposed to refer all our American species of *Ernestia* to *Mericia* Robineau-Desvoidy, since ours have infrascapular setules absent in the genotype of *Ernestia*. Two questions arise here: Is the character of generic value, and is it possessed by the genotype of *Mericia*? As to the first point, there seem to be no North American species of *Ernestia* without infrascapular setules, and they are absent in the European *E. rudis*, type of the genus. They are, however, present in the European *E. connivens* Zetterstedt and *E. pudicus* Rondani (specimens determined by Doctor Villeneuve). Curran has proposed as a supplementary character that the posterior forceps of *Ernestia* are simple (or flat), while in *Mericia* they are keeled. Our American species have them keeled, and so does *connivens*, but *pudicus* has them simple, thus dividing the two characters. As the infrascapular setules are sometimes very few as well as minute, I hesitate to give them generic weight in the absence of other characters. As to my second question, it appears that *Mericia erigonea* Robineau-Desvoidy, the sole original species of the genus, can not be identified and is unknown. Stein³³ says as much. It seems impossible to assume that it has the characters indicated by Curran, who in response to an inquiry informed me that he did not know the species. Hence I should continue to call Walker's species *Ernestia ampelus*.

³⁰ Journ. New York Ent. Soc., vol. 5, 176, 1897.

³¹ Can. Ent., vol. 54, pp. 199 ff., 1921.

³² Ent. News, vol. 35, p. 214, 1924.

³³ Arch. f. Naturg., vol. 90, p. 53, 1924.

Tachina pyste WALKER, List, p. 754. Coquillett (p. 93) placed this in *Eworista*. The type is a female and agrees with the determination of Coquillett. Aldrich and Webber³⁴ make *pyste* a synonym of *maculosa* Meigen of Europe, which Stein³⁵ puts as a synonym of *floralis* Fallen. Brauer and Bergenstamm had referred American specimens to the genus *Nemorilla* Rondani for Coquillett, and this genus is now generally accepted for the species. Hence *Tachina pyste* Walker should be called *Nemorilla floralis* Fallen.

Tachina epicydes WALKER, List, p. 786. Coquillett (p. 94) placed this as a synonym of *Eworista affinis* Fallen. The type is a male from Martins Falls, Albany River, Canada; it runs in the key of Aldrich and Webber to *Zenillia coerulea*, new species, and agrees with the description perfectly except that it appears to have true discals. The abdomen is rubbed and this point is not clear, but I accept the synonymy, sinking *coerulea*.

Eurygaster septentrionalis WALKER, in Lord's "Naturalist in Vancouver Island," vol. 2, p. 339, 1847. Coquillett (p. 102) placed this as a synonym of *Euphorocera claripennis* Macquart. I did not find the type in the British Museum. The description is vague and incomplete, but reads like a *Phorocera*. It is as follows:

Eurygaster septentrionalis, N. S. *Foem.*—Nigra, setosa, latiuscula; capite argenteo-cinereo; vertice aurato; frontalibus atris; palpis rufescentibus; antennis aristae dimidio incrassato; thorace vittis quinque cinereis; scutelli apice piceo; abdomine cinereo subtessellato; alis cinereis.

Female.—Black, setose, rather broad. Head silvery cinereous, gilded above; frontalia deep black, widening in front; facialia bordered with bristles along most of the length from the epistoma. Palpi reddish. Antennae extending to the epistoma; third joint linear, rounded at the tip, full six times the length of the second; arista incrassated for half its length from the base. Thorax with five cinereous stripes; scutellum piceous at the tip. Abdomen slightly tessellated with cinereous, very bristly toward the tip, a little longer than the thorax. Wings cinereous; veins black; prebrachial vein forming an obtuse angle at its flexure, straight from thence to its tip. [Length omitted.]

Tachina melobosis WALKER, List, p. 743. Coquillett (p. 105) could not identify any specimens as belonging to this species, and placed it doubtfully as a *Phorocera*. I saw the type, a male from Florida, but had nothing with me to match it, nor can I find the species in the National Museum; hence I quote the description I made from the type:

Much resembles *Lypha dubia* Fallen in having hairy eyes, large pteropleurals, abdomen thick apically and with discals, the first genital segment shining black and rather large and conspicuous. However, *melobosis* has much longer antennae, and the penultimate joint of the arista is elongate.

Outer vertical larger than a hair; ocellars proclinate and divergent; 2 reclinate frontals, 10 others to second fifth of third antennal joint, fully meeting

³⁴ Proc. U. S. Nat. Mus., vol. 63, art. 17, p. 5, 1924.

³⁵ Arch. f. Naturg., vol. 90, p. 83, 1924.

the bristles on facial ridges. Third antennal joint long and wide, five times the second, upper angle prominent; arista straight, thickened to beyond the middle. Antennal groove deep with sharp edges. Palpi blackish. Pollen of the narrow parafacial rather dark, very thin pollen on parafrontals, which look black. Mesonotum with indistinct stripes. Dorsocentral 3; sternopleural 2, 1; scutellum with 3 lateral, one rather long apical in poor condition. Abdomen shining black, bases of second, third, and fourth segments with band of whitish pollen; venter almost wholly shining in side view, as deep close to the apex as at base. Mid tibia with two very distinct bristles on outer front side; hind tibia with sparse bristles on outer side, not ciliate. Wing subhyaline, fourth vein with rounded, rectangular bend, then very concave, just closing the apical cell barely before the extreme apex; hind cross vein erect, almost in middle between anterior and bend; first vein bare, third with two hairs.

Tachina addita Walker is the female of this, and is so placed by Major Austen.

The species may be left in *Lypha* until further material is found or the related forms revised.

Tachina addita WALKER, *Insecta Saundersiana*, p. 290. Placed by Coquillett (p. 105) as a synonym of the preceding, and I found that Major Austen had made out the same synonymy from the types, with which I fully agreed. The locality was "United States."

Tachina antennata WALKER, *Insecta Saundersiana*, p. 298. Coquillett (p. 105) lists this as unrecognized, perhaps a *Phorocera*. I did not see the type, and nothing has been published upon it as far as I know. The description indicates a very recognizable and remarkable form, if the statements can be relied upon; briefly, it has the eyes hairy, facial ridges bristly, and third antennal joint greatly widened, twice as wide as long; palpi and antennae black. Several species of North American Tachinidae are known with very wide third antennal joint in the male, but all of them that I can find in the collection have bare eyes and bare facial ridges.

Tachina ancilla WALKER, *Insecta Saundersiana*, p. 299. Coquillett (p. 106) placed this in the genus *Frontina*, but he had the wrong species. I found the type to be the same species that Townsend described as *Pseudomyothyria indecisa*.³⁶ Townsend suggested this synonymy in 1918.³⁷ Major Austen³⁸ referred Walker's type to the genus *Frontina*. I referred *indecisa* to the genus *Tachinophyto* (regarding *Pseudomyothyria* as a synonym of the latter).³⁹

Coquillett's species, which he mistook for *ancilla*, has been provided for by Townsend,³⁷ who named it *Frontiniella parancilla*, new genus and species (by misprint *pararcilla*). Townsend compared the new genus with the European genotype of *Frontina*; if he had compared with *Achaetoneura* his differences would have disappeared

³⁶ Trans. Amer. Ent. Soc., vol. 19, p. 132, 1892.

³⁷ Proc. Ent. Soc. Washington, vol. 20, p. 21, 1918.

³⁸ Ann. Mag. Nat. Hist., ser. 7, vol. 19, p. 337, 1907.

³⁹ Insecutor Inscitiae Menstruus, vol. 12, pp. 147, 149, 1924.

except a few very slight ones. Webber, however, in revising the genus *Achaetoneura*,⁴⁰ has left this out; it may stand for the present.

***Tachina violenta* WALKER**, List, p. 788. Coquillett (p. 108) identified this as a species of *Frontina*. The type is a male from Nova Scotia, and is the same species described on an earlier page by Walker as *panaetius*, which I take for the valid name. It is the same species described by Townsend as *Tachinomyia robusta*.⁴¹ In Curran's key to the species of *Tachinomyia*,⁴² the type runs to couplet 3, but I did not venture to spread the genitalia and could not positively exclude *variata* Curran, which, however, seems at most not more than a subspecies of *robusta*. The genus *Tachinomyia* is a distinct one, hence *violenta* in my opinion is a synonym of *Tachinomyia panaetius* Walker.

As to the species misidentified as *violenta* by Coquillett, the specimen with Coquillett's label on was included in *Achaetoneura testacea*, new species, by Webber.⁴³ Coquillett placed *Masicera dubia* Williston⁴⁴ and *Masicera sphingivora* Townsend⁴⁵ as synonyms of his supposed *violenta*. Webber has discussed these on pages 36 and 87 of his recent revision.

***Tachina irrequieta* WALKER**, List, p. 788. Coquillett (p. 108) placed what he identified as this species in *Frontina*. The type is a female of *Tachinomyia panaetius* Walker.

The species misidentified by Coquillett as *irrequieta* is included as *Achaetoneura rileyi* Williston by Webber in his revision of *Achaetoneura*;⁴⁶ Coquillett had already indicated the synonymy of this species with the supposed *irrequieta*.

***Tachina dydas* WALKER**, List, p. 748. Coquillett had no specimens which he could identify as this species, and placed it (p. 108) as a doubtful species of *Frontina*. Major Austen⁴⁷ published a note on the type, making it a synonym of *Eutachina rustica* Meigen. I agree with this disposition after examining the type; but it seems that *simulans* Meigen has some years priority for the species, and the genus *Eutachina* has little to stand on as against *Tachina* of authors (= *Exorista* Meigen according to strict rules, as *larvarum* Linnaeus was the only species originally included in *Exorista*). On this basis the species becomes *Exorista simulans* Meigen.

***Tachina obconica* WALKER**, Insecta Saundersiana, p. 296. Coquillett (p. 110) placed this as a synonym of *Sturmia albifrons* Walker. The type is a female, not a male as Walker thought, and is

⁴⁰ Proc. U. S. Nat. Mus., vol. 78, art. 10, pp. 3, 35, 1930.

⁴¹ Trans. Amer. Ent. Soc., vol. 19, p. 96, 1892.

⁴² Trans. Roy. Soc. Canada, 1926, sec. 5, p. 168.

⁴³ Proc. U. S. Nat. Mus., vol. 78, art. 10, p. 25, 1930.

⁴⁴ Scudder's Butterflies of New England, vol. 3, p. 1924, 1889.

⁴⁵ Trans. Amer. Ent. Soc., vol. 19, p. 238, 1892.

⁴⁶ Proc. U. S. Nat. Mus., vol. 78, art. 10, p. 32, 1930.

⁴⁷ Ann. Mag. Nat. Hist., ser. 7, vol. 19, p. 386, 1907.

the species included by Coquillett on page 115 of his Revision as *Masicera eufitchiae* Townsend, which, however, is not the true *eufitchiae* of Townsend. Director Gillette, of the Colorado Experiment Station, has generously deposited in the National Museum five remaining specimens of the reared lot from which the type of Townsend's species came; I find it almost if not quite the same species that was described later by Tothill⁴⁸ as *Lydella hyphantriae*. Curran⁴⁹ has noted the same point about *hyphantriae*. This, however, does not affect the Walker species, which I refer to *Anetia* Robineau-Desvoidy (*Lydella* of authors).

***Tachina albifrons* WALKER**, Insecta Saundersiana, p. 283. Coquillett (p. 110) placed the species in *Sturmia*, and identified it correctly, according to my examination of the type, which is a female. Walker preoccupied the name *Tachina albifrons* in 1837; hence Townsend⁵⁰ has proposed the name *ricinorum* for the present species and makes it the type of the new genus *Gymnocarcelia*, but without indicating any characters except "quite bare eyes." Without a fuller study than has yet been made of the American forms related to *Sturmia*, it is difficult to estimate the value of some of the characters, but I should call this species *Sturmia ricinorum* Townsend.

***Tachina panaetius* WALKER**, List, p. 767. Coquillett (p. 119) placed this as a synonym of *mella* Walker in the genus *Tachina* of authors. The type is a female from Nova Scotia, and Townsend's *Tachinomyia robusta* is a synonym, which is the next species in Coquillett's Revision. I take *Tachinomyia panaetius* Walker as the valid name for the species, which includes as synonyms Walker's *Tachina pansa*, *T. violenta*, and *T. irrequieta*. Major Austen had placed the four Walker species together as one in the British Museum a long time ago, but had not published his conclusion.

***Tachina pansa* WALKER**, List, p. 787. Coquillett (p. 119) placed this with the preceding under *mella* Walker. The type is a male of *panaetius*.

***Tachina mella* WALKER**, List, p. 767. Coquillett (p. 119) placed this in *Tachina* in the current sense. I did not find the type, the only *mella* that I discovered being one named by Townsend, agreeing with Coquillett's interpretation. There is little doubt that Coquillett had the right species, and no serious question has arisen on the point. The species is a very common northern one, and I think identical with *Exorista larvarum* Linnaeus of Europe, commonly referred to *Tachina* (see note under *Tachina dydas*).

***Tachina hybreas* WALKER**, List, p. 785. Coquillett (p. 119) could not identify the species, but placed it as probably a *Tachina*.

⁴⁸ Can. Dept. Agr. Bull. 3, Tech. Ser., p. 43, 1922.

⁴⁹ Can. Ent., vol. 59, pp. 12, 13, 1927.

⁵⁰ Proc. U. S. Nat. Mus., vol. 56, p. 582, 1919.

Major Austen⁵¹ stated that the type is headless and unrecognizable, perhaps a *Ceromasia*. My notes on it may be of little use, but I quote them:

Female from Martins Falls, Canada. A robust specimen now headless and with several legs gone as well as most of the bristles. Black with yellowish apex of scutellum. Postscutellum well developed. Calypters clear pale yellow. Dorsocentral 4; sternopleural 2, 1, in almost equilateral triangle; scutellum with long and strong apicals like laterals. Abdomen with discals, gray pollinose on whole dorsal surface, but the hind edges of the segments subshining in some lights. Claws small. Third vein with five stout setules; apical cross vein straight, bend oblique.

Tachina helymus WALKER, List, p. 795. Coquillett (p. 126) placed the species in his genus *Metachaeta*. His identification of the species is correct. The type is a female from Maine. Recent authors have combined *Metachaeta* Coquillett and *Phorichaeta* Rondani in the genus *Wagneria* Robineau-Desvoidy, of which the type species in *Musca carbonaria* Panzer. From the key and descriptions given by Stein⁵² and from a single palaearctic specimen in the National Museum, I believe *helymus* is identical with *carbonaria* Panzer and should, therefore, call the species *Wagneria carbonaria* Panzer.

Tachina trixoides WALKER, List, p. 760. Coquillett (p. 138) placed the species as a synonym of *Microphthalma disjuncta* Wiedemann. This was correct, according to information that I received from Major Austen while preparing my revision of the genus *Microphthalma*.⁵³ I did not see Walker's type.

Tachina punctifera WALKER, List, p. 728. Coquillett (p. 141) placed this as a synonym of *Peleteria tessellata* Fabricius, a European species not now believed to occur in North America, and superseded here by *Peleteria iterans* Walker. I saw the types of both and made *punctifera* a synonym of *iterans* Walker.

Tachina anaxias WALKER, List, p. 726. Coquillett (p. 141) placed this as a synonym of *Peleteria robusta* Wiedemann. Curran⁵⁴ has identified it as a distinct species of the same genus. The type is a female from Nova Scotia, hard to identify in a group where the male genitalia are so important; it certainly shows little difference from the type of *apicalis* Walker, also a female, and from California, not Colombia as published. The latter dates from 1852, and I suspect that *confusa* Curran is a synonym of it.

Tachina apicifera WALKER, List, p. 718. Coquillett (p. 142) erroneously made this a synonym of *Archytas analis* Fabricius. Curran redescribed this species as *Archytas vulgaris*, new species,

⁵¹ Ann. Mag. Nat. Hist., ser. 7, vol. 19, p. 336, 1907.

⁵² Arch. f. Naturg., vol. 90, p. 123, 1924.

⁵³ Proc. U. S. Nat. Mus., vol. 69, art. 13, p. 4, 1926.

⁵⁴ Trans. Roy. Soc. Canada, 1925, sec. 5, p. 245.

in his revision of the genus⁵⁵; the species that he called *apicifera* is *californiae* Walker. The type of *apicifera* is a male from "North America"; that of *californiae* is a male from California.

Tachina californiae WALKER, Insecta Saundersiana, p. 270. Coquillett (p. 142) erroneously placed this as a synonym of *Archytas analis* Fabricius. See note under *apicifera*.

Tachina atra WALKER, Insecta Saundersiana, p. 273. Placed by Coquillett (p. 143) as a synonym of *Archytas aterrima* Robineau-Desvoidy. Major Austen⁵⁶ agrees with Coquillett, from the type, with which I agree also. Two other Walker species are synonyms of *aterrima*, but have escaped notice from being described without locality. These are *Tachina metallifera* Walker, List, p. 719; and *Tachina carbonifera* Walker, List, p. 721. Austen thought the two were a single species.⁵⁷ I saw the types of the three.

Tachina candens WALKER, List, p. 720. Placed by Coquillett (p. 143) as a synonym of *Archytas lateralis* Macquart. A female supposed to be from Nova Scotia, but I surmise is neotropical. My notes are as follows:

Female, considerably rubbed; head has been off and glued on, but seems genuine. Has the characters of *Archytas* except that it has, or had, a pair of discals far forward on the second abdominal segment, and still has a single discal on the corresponding part of the third, its mate not developed. Rather large for *Archytas*, the abdomen shining mahogany red or a little darker except fourth segment, which is entirely pollinose above and below. Hairs of face and cheek yellow, abundant; antennae red, third antennal joint black except for two-thirds of the length below, one and one-fourth times the second. The pleurae had yellow hair almost exclusively, and the remaining hairs around edge of dorsum indicate that the mesonotal hairs were yellow. Legs black. Length, 15 mm.

I have been unable to find a specimen in the National Museum agreeing with this description, nor do I know what genus to put it in if the discals exclude it from *Archytas*. At any rate, it should be recognizable hereafter.

Tachina iterans WALKER, p. 727. Coquillett placed this (p. 143) as synonymous with *Archytas lateralis* Macquart. I was able to match the type with a male that I had with me, so took no notes. Curran has the species correctly in his revision of *Peleteria*.⁵⁸ It is properly *Peleteria iterans* Walker. Coquillett was misled by the express statement of Walker, "no bristles on the side of the face," which Austen⁵⁹ says is "precisely the opposite of the fact." A

⁵⁵ Can. Ent., vol. 60, p. 276, 1928.

⁵⁶ Ann. Mag. Nat. Hist., ser. 7, vol. 19, p. 336, 1907.

⁵⁷ Ibid., pp. 337, 338.

⁵⁸ Trans. Roy. Soc. Canada, 1924, sec. 5, p. 238.

⁵⁹ Ann. Mag. Nat. Hist., ser. 7, vol. 19, p. 328, 1907.

synonym is *Tachina punctifera* Walker, List, p. 728, as I saw from the type. *Peleteria iterans* takes the place of *Peleteria tessellata* Fabricius in North American literature.

Tachina decisa WALKER, List, p. 715. Coquillett (p. 143) placed this in the genus *Echinomyia*. The species is almost unmistakable, and he undoubtedly had the right one, and I think it belongs to the genus *Jurinella*. The generic reference requires a rather long discussion, which I postpone for another occasion. I saw the type.

Tachina degenera WALKER, List p., 732. Coquillett (p. 144) placed this in his *Echinomyia* (= *Fabriciella* Bezzi of Tothill's revision) as a synonym of *E. algens* Wiedemann. Major Austen,⁸⁰ however, examined the type and placed it in *Ernestia*, finding the eyes to be hairy. I did not see the type and am unable to add further details.

Tachina signifera WALKER, List, p. 708. Coquillett (p. 145) referred the species to the genus *Epalpus* Rondani. I did not see the type, but it is hardly necessary, for of all Walker's species this is the easiest to identify. It would be almost impossible to mistake it within the area where the type was taken (Nova Scotia). As to the proper genus for *signifera*, Townsend in his Peruvian collecting and later has brought to light a world of related forms without palpi. He has reported on his examination of the type of *signifera* in Revista Ent., vol. 1, p. 167, 1931, where he refers the species to his genus *Argentoepalpus*, of which the type species is *Epalpus niveus* Townsend, from the Peruvian Andes. The genus was described in Insecutor Inscitiae Menstruus, vol. 6, p. 178, 1918, and the type species in the same journal, vol. 2, p. 136, 1914. I have compared *niveus* and *signifera* and agree with this reference.

Tachina finitima WALKER, List, p. 707. Placed by Coquillett (p. 146) as a synonym of *Bombyliomyia abrupta* Wiedemann. I did not see the type, and it has not been reported upon; it is, however, a very recognizable species, which could hardly be mistaken, so I accept Coquillett's specific determination. Townsend⁸¹ has made *abrupta* (of which I have seen the type) the type of *Bombyliopsis*, new genus. I find, however, that the species is so much like the genotype of *Hystricia* that it may very well be left there, so I call the species *Hystricia abrupta* Wiedemann.

⁸⁰ Ann. Mag. Nat. Hist., ser. 7, vol. 19, p. 335, 1907.

⁸¹ Proc. Biol. Soc. Washington, vol. 28, p. 23, 1915.

NORTH AMERICAN TWO-WINGED FLIES OF THE GENUS SPATHIMEIGENIA, WITH DESCRIPTIONS OF FIVE NEW SPECIES

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The present paper contains a discussion of the generic characters of the tachinid genus *Spathimeigenia*, keys for separating the species in both sexes, and descriptions of five new species, with notes on the six heretofore known.

I am under obligations to the authorities of the American Museum of Natural History and of the Massachusetts Agricultural College for the privilege of examining types of species not found in the United States National Museum; to Dr. Alfons Dampf, of the Oficina Federal para la Defensa Agricola, Mexico City, Mexico, for permission to retain for the National Museum a series of specimens of the new species *S. mexicana*; and to William Middleton, of the United States Bureau of Entomology, for revising the nomenclature of the sawflies involved.

Genus SPATHIMEIGENIA Townsend

Spathimeigenia TOWNSEND, Proc. Biol. Soc. Washington, vol. 28, p. 19, 1915.—

CURRAN, Can. Ent., vol. 62, p. 246, 1930.

Hylotomomyia TOWNSEND, Insector Inscitiae Menstruus, vol. 4, p. 31, 1916.

Townsend established the genus *Spathimeigenia* in 1915 by assigning as type the species which Coquillett had erroneously identified as *Tachina demylus* Walker (*Admontia demylus* Walker of Coquillett¹). Believing that Coquillett's species was not the true *demytus*, Townsend named it *spinigera*, designating one of the Coquillett specimens as type. On examining the type of *Tachina demylus* in the British Museum, I found it to be a *Cryptomeigenia*, leaving the name *spinigera* valid for Coquillett's species. Townsend gave no description of the genus and species.

¹ Revision of the Tachinidae of America north of Mexico, U. S. Dept. Agr., Div. Ent., Tech. Ser. No. 7, p. 54, 1897.

The type species of the genus *Hylotomomyia* is *Admontia hylotomae* Coquillett, by original designation. The genus was said to differ from *Spathimeigenia* in having no spines on the fourth segment of the ventral abdominal keel of the female. This is evidently of merely specific importance, and Curran combined the two genera in his revision cited above.

The genus is one of the easiest to recognize, from the presence on the lower part of the parafacial of an area bearing distinct hairs. The female has the abdomen keeled below and bearing stubby spines on the ventral margin of the keel, at least on the third segment. This female character is shared with *Lydella* and several other genera, which all have bare parafacials.

The genotype has the following additional characters among others: Hypopleural bristles and postscutellum present; one vertical bristle in male and female; ocellars proclinate; two upper frontals reclinate, the second pair largest; frontals extending to tip of second antennal joint; front slightly prominent at antennae, the face distinctly receding; facial ridges with several bristles above vibrissae, the latter at oral margin, which is considerably above the lower edge of the head behind; palpi and proboscis of ordinary form, the latter short; antennae extending about three-fourths of the way to the vibrissae, third joint about twice the second, at tip projecting slightly forward (not nearly so much as in *Acemyia*); arista bare. Acrostichal bristles, 3, 3 (one pair just before suture); dorsocentral, 3, 3; presutural, 2 (inner small); supraalar, 3; intraalar, 3; sternopleural, 2, 1; pteropleural small; infrascapular setules absent; scutellum with three lateral pairs and one small discal, the apicals small and upturned. First abdominal segment with a pair of median marginals, second to fourth with discals and marginals, the discals much better developed in male than female, the former having three irregular pairs of different sizes, the latter with usually one small pair. Apical cell ending a little before tip of wing, bend of fourth vein rounded and oblique; hind cross vein in normal position, joining fourth vein at three-fifths of the distance between small and bend.

The genus has a considerable degree of economic importance, and has been reared without exception from sawflies; many rearings are cited under the respective species. Several of the species, however, have not yet been reared.

Eleven species are now known. I have seen the types of all, and with the exception of two they were before me in the preparation of the present paper.

KEYS TO SPECIES OF SPATHIMEIGENIA

MALES

1. Scutellum without the usual pair of slender, upturned, apical bristles (British Columbia)----- buckelli Curran.
Scutellum with slender, upturned apicals----- 2.
2. Parafacial between eye and suture at least twice as wide as third antennal joint----- 3.
Parafacial decidedly less than twice as wide as third antennal joint----- 4.
3. Claws and pulvilli short (Kansas)----- bridwelli, new species.
Claws and pulvilli long (Massachusetts, Indiana, Florida).
hylotomae Coquillett.
4. Claws and pulvilli short; apical cross vein not very oblique (Texas)----- texensis, new species.
Claws and pulvilli long; apical cross vein quite oblique----- 5.
5. Parafacial narrower than the widest part of third antennal joint (Quebec)----- aurifrons Curran.
Parafacial wider than third antennal joint----- 6.
6. Calypters pale yellow or ivory white, opaque (Michigan).
erecta, new species.
Calypters dark and translucent in middle, hind edge yellow----- 7.
7. Abdomen black to tip; palpi a little longer than third antennal joint (Mexico)----- obscura, new species.
Fourth abdominal segment red or reddish at tip; palpi a little shorter than third antennal joint----- 8.
8. Legs black; facial ridges bristly about halfway from vibrissae; parafacial hairs numerous and rather long (Michoacan, Mexico)----- mexicana, new species.
Legs usually red or reddish; facial ridges less bristly; hairs of parafacials less numerous (Northeastern United States; Texas)----- spinigera Townsend.

FEMALES

1. Front with yellow or golden pollen----- 2.
Front with cinereous or silvery pollen----- 4.
2. Fourth abdominal segment wholly black----- aurifrons Curran.
Fourth abdominal segment red at apex----- 3.
3. Legs usually red or reddish; posterior orbit with whitish or silvery pollen----- spinigera Townsend.
Legs black; posterior orbit with golden pollen----- mexicana, new species.
4. Intermediate abdominal segments with discal bristles, small but distinct----- hylotomae Coquillett.
Abdomen without discals----- 5.
5. Tip of third antennal joint distinctly produced upward (Massachusetts)----- nigriventris Smith.
Tip of antennal joint not so produced (Mexico)----- albopicta Bigot.

SPATHIMEIGENIA SPINIGERA Townsend

- Spathimeigenia spinigera* TOWNSEND, Proc. Biol. Soc. Washington, vol. 18, p. 19, 1915.—GREENE, Proc. Ent. Soc. Washington, vol. 23, p. 42, 1921; Proc. U. S. Nat. Mus., vol. 60, p. 11, fig. 90, 1922.—MIDDLETON, Journ. Agr. Res., vol. 20, p. 757, 1921.—JOHNSON, List of the Diptera of New England, p. 186, 1925.—CURRAN, Can. Ent., vol. 62, p. 246, 1930.
- Admontia demylus* WALKER (misidentified) COQUILLETT, Revision of the Tachinidae of America north of Mexico, pp. 9, 53, 1897.—JOHNSON, in Catalogue of the insects of New Jersey, p. 668, 1899; 1910, p. 776.—TOWNSEND, Proc. Ent. Soc. Washington, vol. 14, p. 165, 1912; Journ. New York Ent. Soc., vol. 21, p. 304, 1913.
- Hyperecteina demylus* WALKER (misidentified) SMITH, Proc. Ent. Soc. Washington, vol. 14, p. 126, 1912.—JOHNSON, Diptera of Florida, p. 70, 1913.
- Masicera demylus* WALKER (misidentified) JOHNSON, Diptera of Florida, p. 332, 1895.

The description has been given in part under the generic characters. The legs are usually red, but tend toward brown in some specimens and are black in a few. The pollen of the parafrontals, parafacials, cheeks, and posterior orbit is golden. In the male the abdomen is considerably flattened in good specimens and is more or less reddish at the sides, more so ventrally. The grayish pollen extends from the base beyond the middle on segments 2 and 3, and almost to tip in segment 4, which is red apically. The female has the apical third of the fourth abdominal segment and all the genital structures red; the keel has a strong double row of short, stout spines, beginning on the second segment and continuing well on the fourth.

The nearest related form is *mexicana*, under which I have discussed the rather slight differences.

The National Museum has 10 males and 12 females of *spinigera*, with the following data (the first two rearings were published by Coquillett, 1897, p. 9, and those by Rohwer, Middleton, and Knull by Greene, 1921, p. 42):

One male and one female reared from *Neodiprion abbottii* Leach, collected in Virginia near Washington, D. C., by E. A. Schwarz; the female of these is the one bearing Coquillett's label "*Admontia demylus* Wlk.," which was designated by Townsend as the type of *spinigera*.

One male reared from *Neodiprion lecontei* Fitch, taken in Virginia near Washington, D. C., by Theodor Pergande.

Three males and one female reared from the same host and one male reared from *Neodiprion* sp., all collected at Reading, Pa., by S. A. Rohwer.

One female from the same host, collected at Linglestown, Pa., by William Middleton.

One male and one female reared from same host, taken at Falls Church, Va., by S. A. Rohwer (Hopkins No. 10175, referred to *hylotomae* by Greene, cited above).

One male and four females reared from *Neodiprion americanus* Leach, taken at Falls Church, Va., by William Middleton.

One female reared from *Neodiprion affinis* Rohwer, taken at same place by J. N. Knull.

One female reared from *Neodiprion* sp., taken at same place by S. A. Rohwer.

One female pinned with sawfly cocoon, locality unknown.

Two males, Westfield, Pa., labeled "ex sawfly."

One female reared by J. D. Mitchell at Victoria, Tex., but the notes have been lost. It is a poor, shriveled specimen, but seems to belong here.

For a supposed specimen from California, see under *S. aurifrons*.

Johnson reported the species from Florida. Nearly all the records are within the area comprising New England, New York, New Jersey, Pennsylvania, and the vicinity of Washington, D. C.

Type.—Female, U.S.N.M. No. 19133.

SPATHIMEIGENIA MEXICANA, new species

Besides having all the characters mentioned as pertaining to the genotype, the following may be mentioned:

Male.—Front rather narrow, at narrowest about 0.21 of head width (three measured: 0.2, 0.22, 0.22); pollen deep golden on parafrontals, parafacials, and posterior orbits; face with yellow pollen; facial ridges bristly about halfway up; antennae black; palpi yellow. Thorax with gray pollen, on which are two pairs of inconspicuous stripes, ending considerably before the suture. Abdomen elongate; irregular discals of several sizes on last three segments, hairs large, sparse and erect on last two; pollen gray on last three segments, the apical third or thereabouts brown; generally in an oblique side view it will appear light on one side of the middle line, dark on the other, and these shades will reverse themselves in a different view. Tip of fourth joint red, sometimes a little red on sides of second, rarely on third. Legs black. Anterior tibia with a single outer posterior bristle; middle tibia with one on outer front side, one flexor, and two on outer hind side. Hind tibia with a scattering row of bristles of unequal size on outer hind side. Wings distinctly infuscated toward base, third vein with two or three hairs.

Female.—Front narrowest at extreme vertex, where it measures about 0.29 of head width (three measured: 0.27, 0.3, 0.3), thence very gradually widening, and quite prominent at antennae; facial ridges

with smaller bristles than in male, the uppermost not so high; hairy patch of parafacial reaching nearly to lowest frontals. Shining apical portion of second, third, and fourth abdominal segments narrower, the pollinose portion more uniform in color but still showing the median division in oblique light; fourth segment fully half red. One pair of erect discals on second, third, and fourth segments; keel red on third segment; spines of keel conspicuous on second, third, and fourth segments, but those of second are more slender than the others and somewhat longer.

Length of male, 7–9.5 mm.; of female, 6–7.5 mm.

Described from 19 males and 12 females, all reared from *Neodiprion vallicola* Rohwer, at Erongaricaro, Michoacan, Mexico, and sent to the National Museum by Dr. Alfons Dampf, of the Oficina para la Defensa Agricola of the Mexican Department of Agriculture. Eleven males and six females are returned to Doctor Dampf, the remainder retained in the National Museum. The host sawfly was also sent for determination.

The species is closely related to *spinigera*, but differs in the characters given in the keys, to which may be added that the ground color of the parafacials and cheeks is mostly yellow in the latter, quite black in *mexicana*. The males of *spinigera* have light yellow or grayish pollen on the posterior orbits.

Type.—Male, U.S.N.M. No. 43354.

SPATHIMEIGENIA OBSCURA, new species

This is a large Mexican species similar to *mexicana*, but differs as indicated in the key. It has a striking character, which may be an abnormality in the single specimen—there is a long bristle on each parafacial close to the suture, turned in across the face and appearing without careful scrutiny as one of the bristles of the ridge, but larger than the others. These bristles arise outside the suture but close to it, as stated, and are unlike anything I have ever seen in flies of this relationship.

One male, Mexico, without precise locality, donated by H. J. Reinhard.

Type.—Male, U.S.N.M. No. 43355.

SPATHIMEIGENIA AURIFRONS Curran

Spathimeigenia aurifrons CURRAN, Can. Ent., vol. 62, p. 246, 1930.

Described from eight specimens of both sexes, all reared from *Neodiprion* sp. at Mont Laurier, Quebec, by M. B. Dunn. Type in the Canadian National Collection, Ottawa; paratypes in American Museum of Natural History, New York. The latter institution has donated a female and lent a male, paratypes, to the National Museum.

With these for comparison I have identified three additional specimens in our collection: One male, reared along with several specimens of *spinigera* from *Neodiprion lecontei* Fitch taken at Reading, Pa., by S. A. Rohwer; one male, Redlands, Calif., bred from *Neodiprion edwardsii* Norton, collected by H. E. Burke; and one female from Snow Creek Crossing, Yosemite National Park, Calif., reared probably from a *Neodiprion* by J. M. Miller. The Redlands specimen was referred to *spinigera*, and the Yosemite one to *hylotomae*, by Greene.²

Curran has given a full description of both sexes, but he attached too much importance to the yellow pollen of the front. The fact that the material from Reading, Pa., yielded both this and *spinigera* looks suspicious, but there seem to be two fairly tangible differences when all the material of the two species is examined—the male of *aurifrons* has narrower parafacials, and both sexes have the fourth abdominal segment wholly black.

Paratype.—Female, U.S.N.M. No. 43359.

SPATHIMEIGENIA HYLOTOMAE Coquillett

Admontia hylotomae COQUILLETT, Can. Ent., vol. 30, p. 233, 1898.—JOHNSON, Catalogue of the insects of New Jersey, p. 776, 1909.—TOWNSEND, Journ. New York Ent. Soc., vol. 21, p. 304, 1912.—ESSIG, Insects of western North America, p. 579, 1926.

Hyperceteina hylotomae SMITH, Proc. Ent. Soc. Washington, vol. 14, p. 123, 1912.

Hylotomomyia hylotomae TOWNSEND, Insecutor Inscitiae Menstruus, vol. 4, p. 31, 1916.—GREENE, Proc. Ent. Soc. Washington, vol. 23, p. 42, 1921; Proc. U. S. Nat. Mus., vol. 60, art. 10, p. 11, fig. 57, 1922.—JOHNSON, List of the Diptera of New England, p. 188, 1925.

Spathimeigenia hylotomae CURRAN, Can. Ent., vol. 62, p. 246, 1930.

Male.—Front wider than in *spinigera* (the best two measuring 0.26 and 0.28 of head width), pollen of parafrontals, parafacials, cheek, and posterior orbit subsilvery; eye more diagonal, so that the lower part of the posterior orbit is wider; tip of third antennal joint usually not at all protruding forward; chaetotaxy as in *spinigera*, except that there is only a single large pair of discals on each of the last three abdominal segments; calypters almost pure white; abdomen mostly shining black, with silvery basal bands on last three segments, which in certain lights extend thinly over half or more of the length. Fourth segment wholly black.

Female.—Front about one-third of head width (three measured: 0.32, 0.32, and 0.33); discal bristles small but distinct, one pair to the segment; abdomen with narrower basal silvery bands than in male; keel usually not very prominent, the spines confined to the third segment, piercer as in *spinigera* but somewhat smaller.

² Proc. Ent. Soc. Washington, vol. 23, p. 43, 1921.

Redescribed from 8 males and 10 females in the National Museum collection. The type series consists of 3 males and 4 females, Woods Hole, Mass., bred from *Hylotoma humeralis* Beauvois by H. G. Dyar. Three additional males were bred from *Arge* sp. at East River, Conn., by C. R. Ely; 4 females bred at Falls Church, Va., from *Arge* sp., by Carl Heinrich; 1 female bred at Westerly, R. I., by workers at the Gypsy Moth Laboratory. One female was collected at Miami, Fla., by Townsend; 1 male at La Fayette, Ind., by myself; and 1 male from Massachusetts has no collector label.

Type.—Male, U.S.N.M. No. 4061.

SPATHIMEIGENIA NIGRIVENTRIS Smith

Spathimeigenia nigriventris SMITH, Psyche, vol. 24, p. 139, 1917.—JOHNSON, List of the Diptera of New England, p. 185, 1925.

Described from a single female in the collection of the Massachusetts Agricultural College, presumably from Massachusetts. The type has been generously loaned to the National Museum for my examination. The pollen of the front is cinereous, not yellow. There are absolutely no discal bristles, even minute ones. The fourth abdominal segment is wholly black; the keel is well developed, bearing on the third segment four pairs of blunt spines, and on the fourth segment two pairs, the second segment with about two somewhat longer and less blunt. The apical cross vein is not so oblique as in *spinigera* and the others, sharing this peculiarity with *tewensis*. Infrascapular setules absent. For other characters, see original description.

SPATHIMEIGENIA ERECTA, new species

Male.—Front narrow (0.21 and 0.23 of head width in the two specimens); parafrontals light yellow pollinose, the parafacials, cheeks, and posterior orbits subsilvery; antennae black, third joint twice the second, slightly upturned and pointed at tip; last three abdominal segments with a one or two pairs of discals and several much smaller erect large hairs or very small bristles; a longitudinal area between the discals is changeable in color from the median line, one half looking dark when the other is light, and reversing when viewed at a different angle. Fourth segment very obscurely reddish at tip. Sides of abdomen reddish in ground color toward base. Otherwise as in *spinigera*.

Length, 7.4 mm.

Female.—Unknown.

Described from two males, reared at Kalamazoo, Mich., from *Neodiprion* sp. by R. A. Todd. Date of emergence, August 27, 1903.

Type.—Male, U.S.N.M. No. 43356.

SPATHIMEIGENIA BRIDWELLI, new species

Male.—Front narrowest at extreme vertex, where it is 0.35 of the head width by micrometer measurement—the widest of any of the species. The parafrontals and parafacials are also wider than in the others, the former being but little narrower on each side than the frontal stripe, the latter as wide as three-fourths the length of the third antennal joint; cheek wide, three-sevenths of the eye height. The pollen of the parafrontals, parafacials, cheeks, and posterior orbit is subsilvery, with no yellow tinge. Antennae black, rather short, third joint barely twice the second. Facial ridges with four or five small bristles, extending about one-fourth of the way to base of antennae. The parafacial has the usual group of black hairs, which are rather numerous and almost cover the lower two-thirds. Thoracic chaetotaxy as in genotype, except that there is no inner presutural. Abdomen shining black with very narrow silvery basal bands on segments 2, 3, and 4; on the sides of the last two a very delicate tomentum forms a grayish subopaque patch on each, rounded above and covering all but the anterior and posterior edges (this is a very characteristic feature, similar to the "sexual patch" that occurs in other male tachinids, and should readily identify the species).

Legs black; claws and pulvilli short. Front tibia with two bristles on outer hind side, middle tibia with two on outer front.

Wings slightly darkened toward base; calypters white.

Length, 7 mm.

One male, Baldwin, Kans., June, collected by J. C. Bridwell.

Type.—Male, U.S.N.M. No. 43357.

SPATHIMEIGENIA TEXENSIS, new species

Male.—Front rather wide, at vertex measuring in the single specimen 0.32 of head width, continuing at same width three-fourths of the way to antennae. Pollen subsilvery on parafrontals, parafacials, cheeks, and posterior orbits. Facial ridges bristly two-fifths of the way to base of antennae. Parafacial narrower than third antennal joint, with rather sparse dark hairs from the middle downward. Antennae black, second joint a little shorter than in the other species, hardly one-half the third, which is rounded at apex. Cheek one-fifth eye height. Thorax with subsilvery pollen, not so grayish as in other species; chaetotaxy as in genotype. Abdomen badly damaged, but the last three segments appear to be shining on posterior half, discals if present must have been minute. Legs black; claws and pulvilli small. Wings rather evenly pale brownish, apical cross

vein less oblique than in any of the other species except *bridwelli*, the bend might almost be called a rounded angle. Calypters white.

Length, about 8 mm.

One male, Brownsville, Tex., collected by C. H. T. Townsend.

Type.—Male, U.S.N.M. No. 43358.

SPATHIMEIGENIA BUCKELLI Curran

Spathimeigenia buckelli CURRAN, Can. Ent., vol. 58, p. 216, 1926.

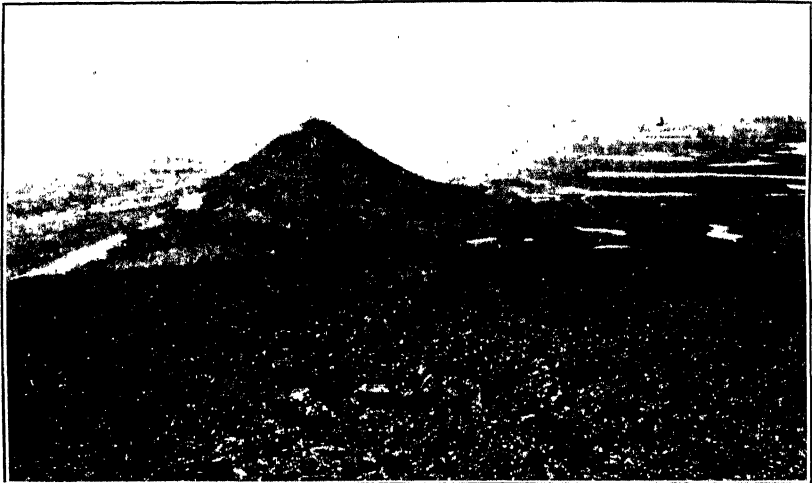
Described from a single male, collected at Osoyoos, British Columbia, by E. R. Buckell. The type is in the Canadian National Collection. It was in my possession several years ago for determination, and was labeled by me "*Hylotomomyia*, n. sp." I have not seen it since and have no notes on its characters. Curran has given a complete description, which is readily accessible. The absence of the small apical scutellars, with the well-developed outer verticals, silvery head pollen, and wide parafacials will make it easily recognizable. It is not represented in the National Museum, and there is no record of any specimens except the type.

SPATHIMEIGENIA ALBOPICTA Bigot

Chaetolyga albopicta BIGOT, Ann. Soc. Ent. France, 1888, p. 258.

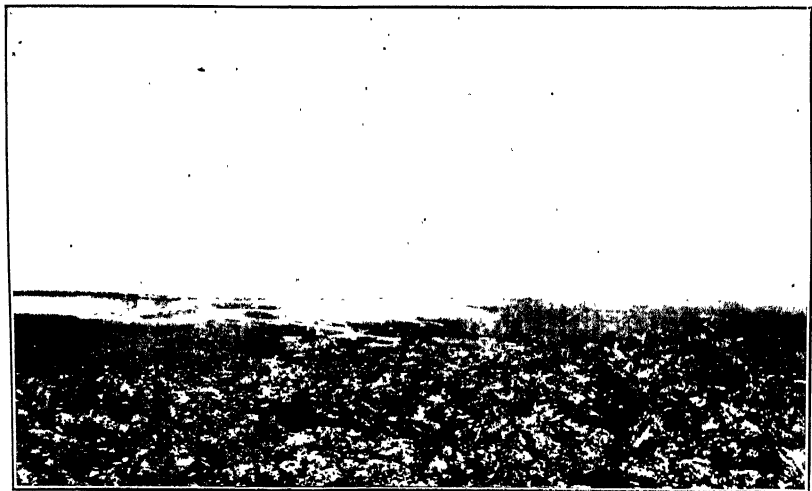
Gymnostylia albopicta BRAUER, Sitz. Kais. Akad., vol. 106, p. 351, 1897.

Briefly described by Bigot from two females, locality "Mexico." Brauer saw the types and referred them to *Gymnostylia*. I saw the types in Mr. Collin's collection at Newmarket, comparing them with an authentic specimen of *hylotomae* that I had with me. There is no question about the generic reference; my notes state that the species is "a *Spathimeigenia*, having fine hairs on the lower part of parafacial, no infrasquamal setules, piercer in female, etc. Differs from *hylotomae* in having cheek one-fifth of eye height, no discals on second, third, and fourth abdominal segments. Very similar in other characters." I know of no other specimens in collections.



INTERIOR OF ST. LAWRENCE ISLAND

Looking west from the top of the mountain at Cape Kialegak, at the southeast end of the island.



CAPE KIALEGAK

Southeast end of St. Lawrence Island.

THE BIRDS OF ST. LAWRENCE ISLAND, BERING SEA

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During the summer of 1930, Henry B. Collins, jr., of the Division of Anthropology of the United States National Museum, made an expedition to St. Lawrence Island, Bering Sea. Although the chief aims of his trip were in the fields of archeology and anthropology, he used his spare time to advantage in collecting biological material as well. Among the latter were 109 bird skins, constituting the largest single ornithological collection ever made on that island. These specimens have been carefully studied and form the basis of this paper, but inasmuch as so little has been written about the bird life of St. Lawrence Island, I have included all previously published data as well, making the present contribution as complete as possible.

St. Lawrence Island is one of the northwestern outliers of the area covered by the American Ornithologists' Union Check-List, the official list of the birds of the North American faunal region, but geographically it is as much a part of Asia as of North America. Because of its position as a spatial link between the Palearctic and the Nearctic regions, St. Lawrence Island possesses more interest than might otherwise be attached to a semibarren island of its size. (Figs. 1 and 2.)

The best description of St. Lawrence Island is that given by John Muir in his book "The Cruise of the *Corwin*." Unfortunately many of his statements about the theoretical glaciation of the island have since been discredited, and recent expert opinion has been to the effect that the island never was glaciated. By omitting the inaccurate statements of past history, however, we may extract a fair picture of the place from Muir's writings.

St. Lawrence Island, the largest in Bering Sea, is situated at a distance of about 120 miles off the mouth of the Yukon, and 45 miles from the nearest point on the coast of Siberia. It is about 100 miles in length from east to west and 15 miles in average width, a dreary, cheerless-looking mass of black lava, dotted with volcanoes, covered with snow, without a single tree * * *.

* * * It is traversed by numerous valleys and ridges and low gaps
 * * *. Nearly all the volcanic cones with which the central part of the
 island is in great part covered * * * present well-formed craters but little
 weathered as yet.

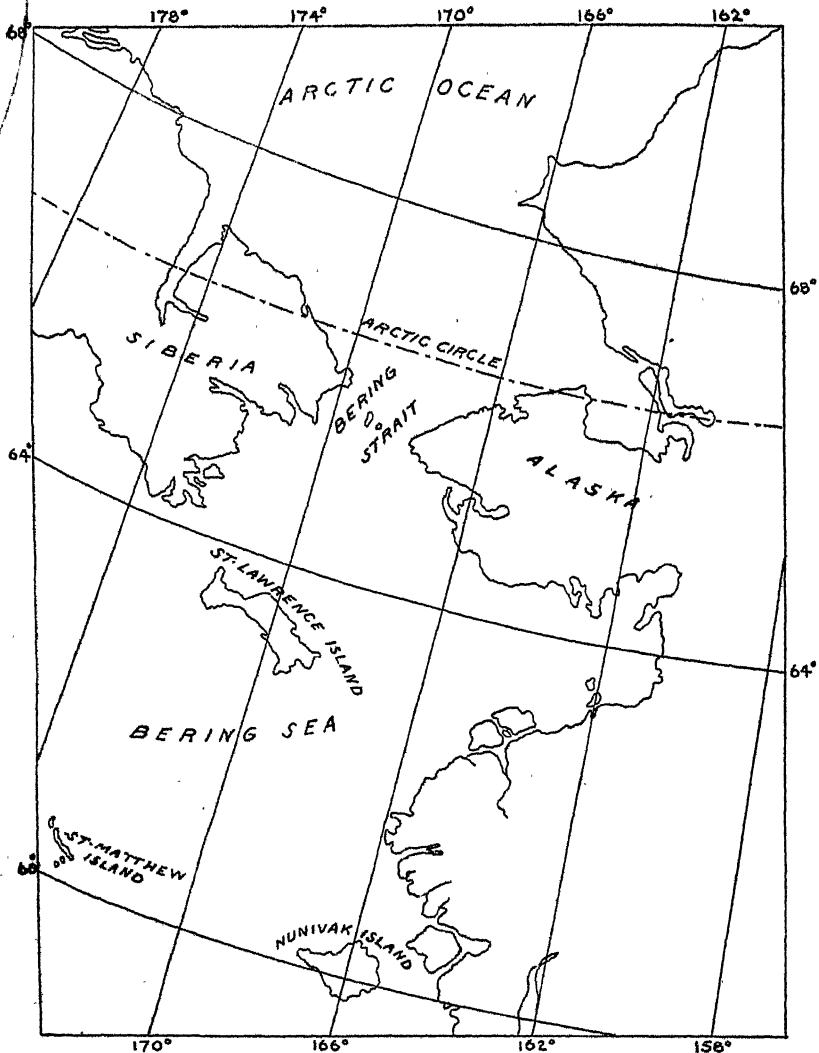


FIGURE 1.—Map of the Bering Sea region, showing the location of St. Lawrence Island with reference to Asia and North America

All the surface of the low grounds * * * is covered with wet, spongy tundra of mosses and lichens, with patches of blooming heathworts and dwarf willows, and grasses and sedges, diversified here and there by drier spots, planted with larkspurs, saxifrages, daisies, primulas, anemones, ferns, etc. These form gardens with a luxuriance and brightness of color little to be hoped for in so cold and dreary-looking a region.

In another place he writes of the advent of summer on the island. On May 28 winter was still in full possession of the place, but 11 days later he found—

* * * the dwarf willows, drabas, erigerons, and saxifrages pushing up their buds and leaves, on spots bare of snow, with wonderful rapidity. This was the beginning of spring at the northwest end of the island. On July 4 the flora seemed to have reached its highest development. The bottoms of the * * * valleys were in many places covered with tall grasses and carices evenly planted and forming meadows of considerable size, while the drier portions, and the sloping grounds about them were enlivened with gay, highly colored flowers, * * *

The environmental conditions existing at present in St. Lawrence Island are very different from those that obtained there in the Tertiary, but the avifauna is wholly that of the surrounding tundra

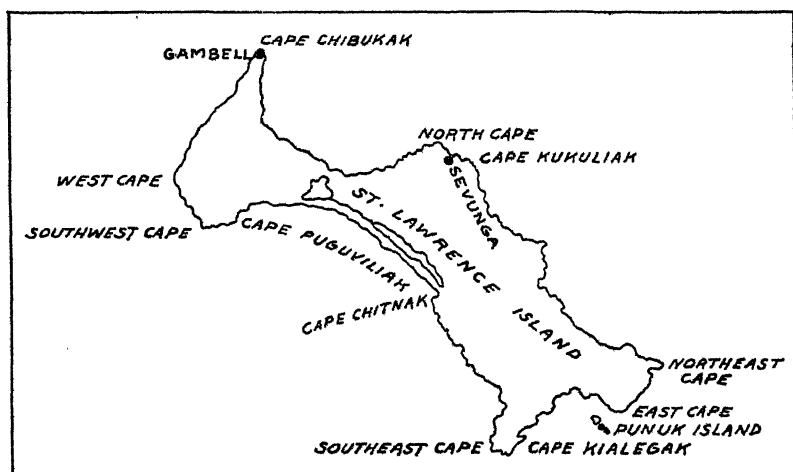


FIGURE 2.—St. Lawrence Island, Bering Sea, showing localities mentioned in this paper

country of Siberia on the one hand and of Alaska on the other. At the suggestion of Prof. R. W. Chaney, of the Carnegie Institution of Washington, Collins searched for, and found, fossiliferous shales of Tertiary age, which, on examination, proved to contain remains of sequoias, poplars, and other plants. The former existence of these trees on the island, now so destitute of arboreal vegetation, is looked upon by Chaney as strong evidence of a former land connection across Bering Straits between Siberia and Alaska, as sequoias have been found in a fossilized state in both those regions and in Mongolia, although they are now restricted in living condition to California. That the birds do not reflect the history of the island is not remarkable, as the distance from the west end of the island to Siberia is only some 40 miles, a readily negotiable flight for any of the birds now inhabiting it.

Surrounded by angry seas, closed to navigation for a good part of the year, St. Lawrence Island has been visited but rarely, in contrast to some of the other islands, such as the Pribilofs, and most of the few parties that touched its bleak shores remained for only very short periods of time. In fact, so little work has been done there in natural history that it is possible to outline every such attempt in a short paper such as this.

The first mention of the island is to be found in Vitus Bering's journal.¹ On August 8, 1728, when in latitude $64^{\circ} 30' N.$, Bering met with eight Chukchi men who asked him who he was and why he came. "On being invited on board, they put one man over, who * * * swam over to have a talk with us. A little later the boat moved up to us and the men in it told us * * * that a short distance from here the coast turns to the west, and that not far ahead of us is an island. We located this island, which we named St. Lawrence, in honor of the day, and found on it a few huts but no people, although I twice sent the midshipmen to look for them." It may be noted that while the date in the journal reads August 8, the map shows that St. Lawrence Island was visited on August 10. There is nothing in Bering's account to indicate that he or any of his men actually landed on the island, and, as a matter of fact, Dall² writes definitely that Bering did not land there but merely cruised off its shores.

In 1767 Lieutenant Sind saw several clusters of small islands, which were probably the peaks of the old volcanoes on St. Lawrence and which seemed like separate little islands in the fog. He did not land there, and his journey leaves us no richer in information about St. Lawrence.

In 1777 Capt. James Cook saw the western highlands of the island and named the land Clerke's Island. In the account of his celebrated voyage³ we find that "* * * Clerke's Island * * * stands in the latitude of $63^{\circ} 15'$, and in the longitude of $190^{\circ} 30'$. It seemed to be an island of considerable extent, in which are several hills, all connected by low ground, so that it looks, at a distance, like a group of islands." In another entry⁴ is the first note on record of the bird life of this island: "About midnight, the Isle of St. Lawrence was five or six miles distant * * *. We were ac-

¹ Bering's voyages. An account of the efforts of the Russians to determine the relation of Asia and America, vol. 1, p. 18, 1922. Edited by F. A. Golder, published by the American Geographical Society.

² Dall, W. H., A critical review of Bering's first expedition, 1725-1730, together with a translation of his original report upon it, with a map. Nat. Geogr. Mag., vol. 2, no. 2, p. 31, 1890.

³ Cook, Capt. James, and King, Capt. James, A voyage to the Pacific Ocean, undertaken by command of His Majesty, for making discoveries in the Northern Hemisphere; Performed under the direction of Captains Cook, Clerke, and Gore in the year 1776, 1777, 1778, 1779, and 1780, vol. 3, pp. 83, 84, 1784.

⁴ Idem. vol. 4. pp. 19. 20.

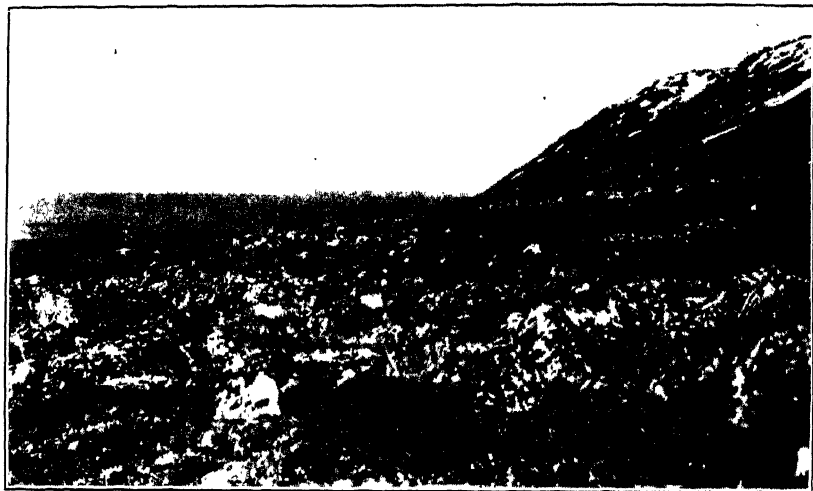


GAMBELL, NORTHWEST END OF ST. LAWRENCE ISLAND

Photo taken in October, 1930.



THE MOUNTAIN BACK OF GAMBELL



TWO VIEWS OF THE CAPE AT GAMBELL

accompanied with sea fowl of various sorts, and observed some guillemots and small crested hawks." Cook believed to the end that Clerke's and St. Lawrence were two separate islands, and we find that on the map in Pennant's "Arctic Zoology" the island is called Clerke's Island.

St. Lawrence Island was first actually visited in 1816, when Kotzebue's party, of whom Eschscholtz was the naturalist, landed there. They returned again in 1817, when Louis Choris also landed there on June 28 (July 10 old style). Kotzebue's contribution to knowledge of the fauna of the island is not very extensive. All he wrote in this connection was that the " * * * reindeer, which belongs to both coasts, seems to be wanting in St. Lawrence Island." Choris⁶ figures *Alcella pygmaea* from St. Lawrence Island, this being the first definitely identifiable bird record for the island.

Captain Beechey took his ship, H. M. S. *Blossom*, to St. Lawrence Island in 1826, and Vigors, in his report on the ornithology of that famous voyage,⁷ lists *Ciceronia pusilla* (under the name *Cerorhinca occidentalis*) as being brought off from St. Lawrence Island in great abundance.

The island was not visited again until the now historic cruise of the *Corwin* in 1881, when E. W. Nelson and John Muir, among others, landed on St. Lawrence. Nelson recorded about 20 forms of birds, this being the first attempt at a list of its avifauna. The total time spent on the island was short, May 28 to 31 and June 7 to 9. H. W. Elliott and Lucien M. Turner also made short visits to St. Lawrence Island about this time.

A number of the members of the Harriman Alaska Expedition spent part of a day, July 13, 1899, on St. Lawrence Island. The landing party included Robert Ridgway, C. Hart Merriam, A. K. Fisher, and L. J. Cole. Unfortunately but little opportunity was given to make observations on the birds. They collected 16 specimens of 6 species and made notes on 3 others. Doctor Fisher has very kindly sent me his notes of that day for use in this paper.

During the summer of 1896, Alvin Seale and N. B. Scofield made a journey to Point Barrow and passed close by St. Lawrence Island on July 1, and noted three species there.

W. Sprague Brooks and Joseph Dixon spent a good part of June, 1913, on St. Lawrence Island and noted 22 kinds of birds, collecting specimens of the majority. F. Seymour Hersey was on the island

⁵ Pennant, Thomas, Arctic zoology, vol. 2, map. 2, 1785.

⁶ Choris, L., Voyage pittoresque autour du monde, p. 20, 1822.

⁷ Vigors, N. A., in Beechey, F. W., The zoology of Captain Beechey's voyage; compiled from the collections and notes made by Captain Beechey, the officers and naturalist of the expedition during a voyage to the Pacific and Bering's Straits performed in His Majesty's ship *Blossom* under the command of Capt. F. W. Beechey. * * * in the years 1825, 26, 27, and 28. Ornithology, pp. 13-40, pl. i-xliv, 1839.

for two days, July 24 and 25, in 1914. Alfred M. Bailey and Russell W. Hendee collected on St. Lawrence late in June and early in July, 1921, and Hendee again visited it in August, 1922. They found a resident teacher on the island, Mr. Dupertius, of the Bureau of Education, who was interested in birds and who had made some observations there. Except for a few fragments given by Bailey, none of Dupertius's notes have been published.

F. L. Jaques passed close by St. Lawrence in 1928 and noted three species of birds offshore.

Finally, in the summer of 1930, Henry B. Collins, jr., spent several months on the island from June 19 to October 22, and collected birds as time permitted.

The present paper is merely a descriptive list of the birds known to occur on St. Lawrence Island. Undoubtedly other species will have to be added as more collecting is done there, especially among the small land birds and the shorebirds. Mr. Collins tells me that he saw some hawks there but was unable to procure a specimen. No published record of a hawk from St. Lawrence Island is known to me, so that is another form to be added in the future.

Inasmuch as Harry S. Swarth, of the California Academy of Sciences, is working on a comprehensive paper on the Bering Sea avifauna, I have not attempted any interpretative work on any of the distributional problems and am restricting this paper to the status of a reference list.

The present list contains 61 species of birds. Of these the following eight have not been recorded from the island before:

Gavia arctica pacifica.

Gavia stellata.

Mareca penelope.

Limosa lapponica baueri.

Larus argentatus vegae.

Cephus grylle mandti.

Ououlus canorus bakeri.

Nyctea nyctea.

In addition to the 61 species now definitely known from St. Lawrence Island, three others have been stated by Nelson⁸ to occur there "undoubtedly." These birds, for which definite records are lacking, are *Nettion carolinense*, the green-winged teal, *Phaeopus hudsonicus*, the Hudsonian curlew, and *Pisobia bairdi*, Baird's sandpiper.

The reference to the original description of each species is given, and this is followed by a complete synonymy as far as the literature of St. Lawrence Island is concerned. All the birds collected by Collins, as well as those obtained by the Harriman Expedition, are in the United States National Museum (including the collection of the Biological Survey).

The specimens without data, listed in this paper, were purchased by Mr. Collins from various Eskimos at Gambell.

⁸ Nelson, E. W., Birds of Bering Sea and the Arctic Ocean. Cruise of the revenue-steamer *Corwin* in Alaska and the NW. Arctic Ocean in 1881, pp. 88, 90, 97, 1883.

The photographs illustrating this paper (pls. 1-6) are all by Mr. Collins.

Family GAVIIDAE, Loons

GAVIA ADAMSI (Gray)

YELLOW-BILLED LOON

Colymbus adamsi GRAY, Proc. Zool. Soc. London, 1859, p. 167 (Russian America through Bering Straits=Alaska).

Gavia adamsi, BAILEY, Condor, vol. 27, p. 26, 1925.

Collins collected two adult specimens in good summer plumage. Unfortunately neither was sexed or dated. Both were taken at Gambell, in the northwestern part of the island. Bailey saw one near the old village of Kookooluk (Kukuliak) on June 28, the only previous record for St. Lawrence. It is not known whether it breeds there.

This species is said to be a late-nesting bird. It is all the more unfortunate that the present two specimens are without dates, as they may be migrants or may have been late enough to have been breeding on St. Lawrence.

A third specimen, a female, taken on October 14, is in fresh winter plumage. Judging by its smaller size, it appears that the two summer-plumaged birds were males.

GAVIA ARCTICA PACIFICA (Lawrence)

PACIFIC LOON

Colymbus pacificus LAWRENCE, in Baird, Cassin, and Lawrence, Report of explorations and surveys, etc., for a railroad from the Mississippi River to the Pacific Ocean, vol. 9, Birds, pp. liv, 887, 889, 1858 ("San Diego, Calif., and Puget Sound"—Presidio, near San Francisco, Calif.).

Collins obtained 10 of these loons, two of them juvenals, the rest adults of both sexes, all in winter plumage. The specimens with dates were taken from September 23 to October 16. A full-grown juvenal was shot on September 23. A male, collected on October 14, still has some of the summer plumage on the back and has a few black feathers on the chin and throat. All were collected at Gambell.

I am not aware of any satisfactory way of telling winter-plumaged specimens of *G. a. viridigularis* from *G. a. pacifica* and regret the absence of summer adults from St. Lawrence Island. Hartert⁹ gives measurements that imply a longer bill in *viridigularis*. If we use this as a criterion, all the present birds are *pacifica*.

The postnuptial molt must follow very quickly on the termination of nesting activities, as all but one of the adults are in full winter plumage.

⁹ Die Vögel der paläarktischen Fauna, vol. 2, p. 1461, 1920.

A number of the birds have the new remiges only partly grown and were probably quite flightless at the time. All the loons appear to shed all their wing quills simultaneously. It is worthy of note that they first acquire the more somber winter feathering and then go through the temporary period of flightlessness.

This bird was not previously known to inhabit St. Lawrence Island.

GAVIA STELLATA (Pontoppidan)

RED-THROATED LOON

Colymbus Stellatus PONTOPPIDAN, Danske Atlas e. Konge-Riget Dannemark med dets naturlige Egenskaber, vol. 1, p. 621, 1763 (no locality mentioned= Denmark).

Collins obtained two adults in breeding plumage and two birds in winter feathering. The two latter are females, one adult and one immature. The summer birds are without dates; the adult female in winter dress was shot on October 9; the immature bird in September. All were taken at Gambell.

The red-throated loon has not been recorded from St. Lawrence Island before. It is rather strange that Brooks, Bailey, Hendee, and others who made collections and observations there should have failed to see it, and it may be assumed that it is less numerous on the island than the Pacific loon.

Family DIOMEDEIDAE, Albatrosses

DIOMEDEA ALBATRUS Pallas

SHORT-TAILED ALBATROSS

Diomedea albatrus PALLAS, Spicilegia zoologica, etc., vol. 1, fasc. v, p. 28, 1769 (ad oram Kamtschateae orientalem * * * ad insulam Beringii= Bering Sea).

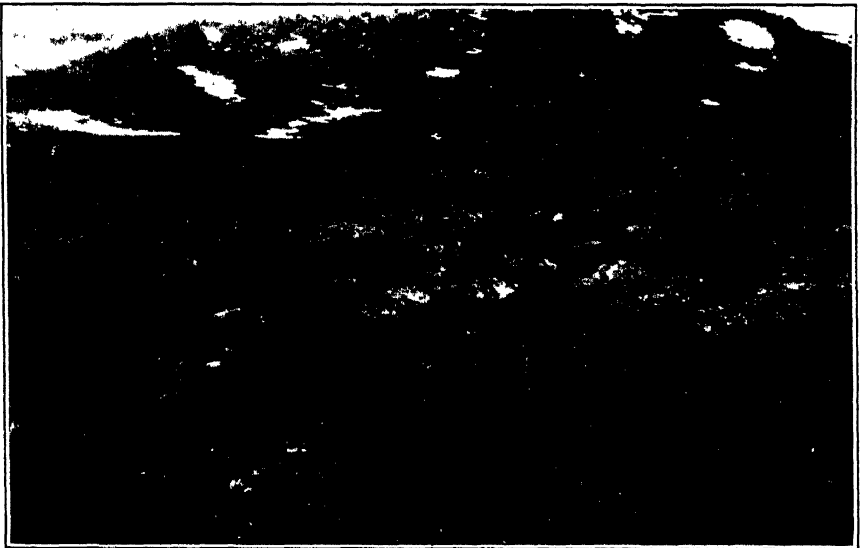
Diomedea brachyura, NELSON, Birds of Bering Sea, etc., Cruise of the *Corwin*, p. 111, 1883.

Diomedea albatrus, TURNER, Contr. Nat. Hist. Alaska, no. 11, p. 128, 1886.—NELSON, Report upon natural history collections made in Alaska, p. 61, 1887.

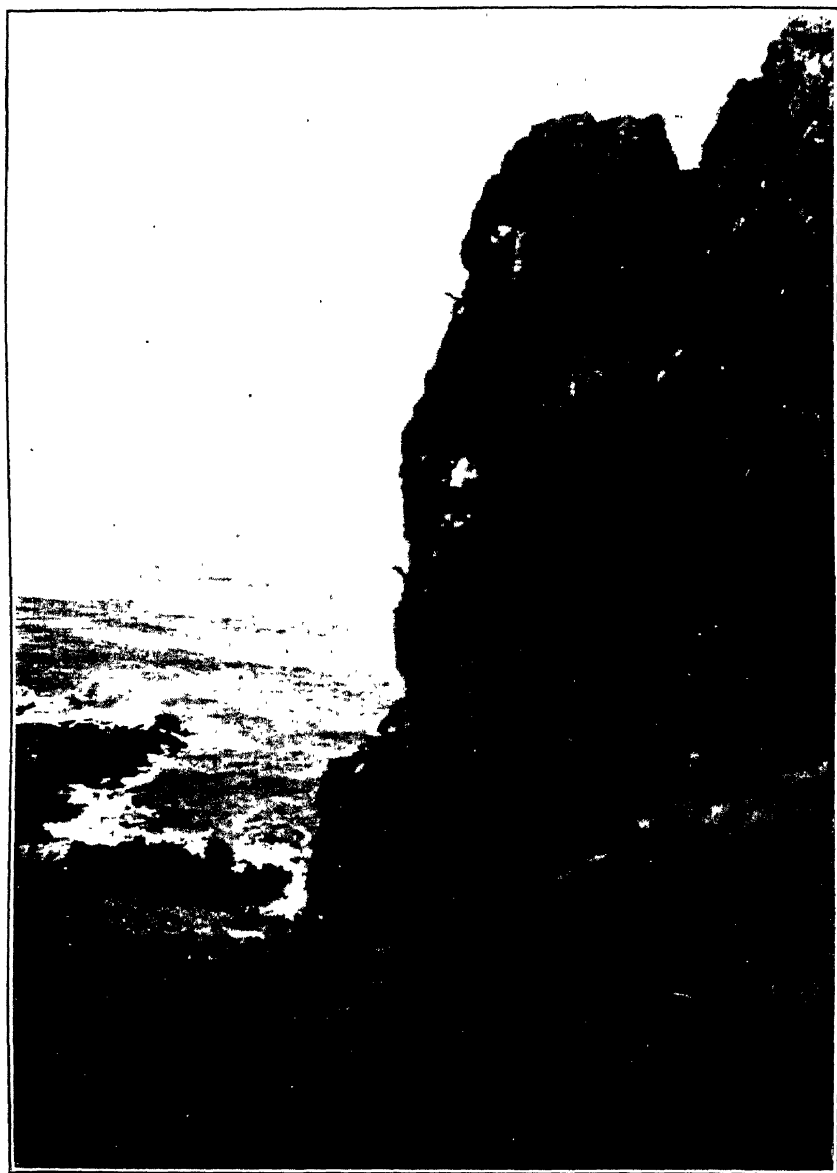
Nelson notes that "adults of this species were seen between St. Lawrence Island and Plover Bay, Siberia, and the mandibles of two specimens were obtained in the ruined villages on St. Lawrence Island." Turner saw this albatross at sea near the island, but it appears that the only definite records for the island itself are the two mandibles found by Nelson, and these may have gotten there by hand of man. Collins collected a maxilla of this species in the second oldest village site at Gambell. The ruins with which it was associated are at least 1,000 years old.



NEST AND YOUNG OF RAVEN (*CORVUS*
CORAX PRINCIPALIS)
On cliff back of Gambell.



VIEW AT GAMBELL



CORMORANTS NESTING ON PUNUK ISLAND

Four miles off the east end of St. Lawrence Island.

Family PROCELLARIIDAE, Shearwaters, Fulmars

FULMARUS GLACIALIS RODGERSI Cassin

RODGER'S FULMAR

Fulmarus Rodgersti CASSIN, Proc. Acad. Nat. Sci. Philadelphia, 1862 (Oct. 28), p. 326 (South Indian Ocean=North Pacific).

Fulmarus glacialis rodgersi, NELSON, Birds of Bering Sea, etc., Cruise of the *Corwin*, p. 112, 1883; Report upon natural history collections made in Alaska, p. 62, 1887.—A. O. U. check-list of North American birds, ed. 4, p. 12, 1931.

Fulmarus glacialis rodgersii, HARTERT, Die Vögel der paläarktischen Fauna, vol. 2, p. 1438, 1920.

Fulmarus glacialis glupischa, BROOKS, Bull. Mus. Comp. Zool., vol. 59, pp. 368, 369, 1915.

Fulmarus rodgersi, BENT, U. S. Nat. Mus. Bull. 121, p. 46, 1922.

Nelson saw this fulmar in abundance off St. Lawrence Island. Brooks noted quite a number during the last week in May, while crossing Bering Sea from Cape Zhipanov, Kamchatka, to St. Lawrence Island. According to Hartert and Bent, this bird breeds on St. Lawrence Island.

Family HYDROBATIDAE, Small Petrels

OCEANODROMA FURCATA (Gmelin)

FORK-TAILED PETREL

Procellaria furcata GMELIN, Systema naturae, vol. 1, pt. ii, p. 561, 1789 (based on the Fork-tail Petrel, Pennant, Arctic zoology, vol. 2, p. 535: In glacie maris Americam et Asiam interfuentis—"among the ice between Asia and America," Pennant).

Oceanodroma furcata, NELSON, Report upon natural history collections made in Alaska, p. 64, 1887.—GODMAN, Monograph of the petrels, p. 87, 1907-1910.

This petrel figures in the present list solely on the basis of Nelson's statement that during "the cruise of the *Corwin*, in 1881, these petrels were seen on several occasions in Bering Straits and about St. Lawrence Island and in Plover Bay, Siberia."

Family PHALACROCORACIDAE, Cormorants

PHALACROCORAX PELAGICUS PELAGICUS Pallas

PELAGIC CORMORANT

Phalacrocorax pelagicus PALLAS, Zoographia Rosso-Asiatica, vol. 2, p. 303, pl. 76, 1811 (maris Camtschatlici orientalis et Americanorum insularum incolae=Aleutian Islands).

Phalacrocorax pelagicus pelagicus, BROOKS, Bull. Mus. Comp. Zool., vol. 59, p. 397, 1915.—BENT, U. S. Nat. Mus. Bull. 107, p. 275, 1919.—BAILEY, Condor, vol. 27, p. 167, 1925.—A. O. U. check-list of North American birds, ed. 4, p. 24, 1931.

Nelson¹⁰ does not definitely record this cormorant from St. Lawrence Island, but writes that it is the "commonest of its kind * * * about the shores of the various islands in Bering Sea * * *." Bent records it as breeding on St. Lawrence, and Bailey found the birds "fairly abundant at St. Lawrence Island, where they were nesting along the cliffs below Sivunga, the first week in July."

Collins brought back four specimens, three adults and one fully grown immature just beginning to molt from the brown plumage to the lustrous violet and greenish black of the adult state. This immature bird was a male, shot on July 22; two of the adults are without data; the last adult, a male, was collected on October 11. All were taken at Gambell.

The year-old immature bird is in an early stage of molt, although it was collected so late in the summer. It would seem that this species is as variable in its molting season as is the double-crested cormorant, *P. auritus auritus*, of which Lewis¹¹ writes as follows:

The time of beginning of the molt out of the first winter plumage varies much in different individuals * * * it may begin as early as February, while in the same birds it does not appear to begin before the first of the following August. Some individuals apparently complete it by the middle of July or some afterwards, while in others it is still incomplete at the end of September * * *.

Brooks found this species beginning to lay by June 2, on St. Lawrence, "and eggs in an advanced state of incubation were taken * * * on June 28."

PHALACROCORAX URILE (Gmelin)

RED-FACED CORMORANT

Pelecanus Urile GMELIN, Systema naturae, vol. 1, pt. ii, p. 575, 1789 (in Camtschatcae rupestribus maritimis=Kamchatka).

Phalacrocorax urile, NELSON, Report upon natural history collections made in Alaska, p. 65, 1887.

Nelson is the only naturalist who has recorded the red-faced cormorant from St. Lawrence Island. According to him, it is a "more or less common summer resident" there.

Family ANATIDAE, Ducks, Geese, Swans

CYGNUS COLUMBIANUS (Ord)

WHISTLING SWAN

Anas columbianus ORD, in Guthrie's Geography, 2d Amer. ed., p. 319, 1815 (below the great narrows of the Columbia River).

Olor columbianus, BROOKS, Bull. Mus. Comp. Zool., vol. 59, p. 388, 1915.

¹⁰ Nelson, E. W., Birds of Bering Sea and the Arctic Ocean. Cruise of the revenue steamer *Corwin* in Alaska and the NW. Arctic Ocean in 1881, p. 103, 1883.

¹¹ Lewis, Harrison F., The natural history of the double-crested cormorant (*Phalacrocorax auritus auritus* (Lesson).) Ru-Mi-Lou Books, Ottawa, Canada, p. 58, 1929.

Ocygnus columbianus, BAILEY, Condor, vol. 27, p. 206, 1925.—BENT, U. S. Nat. Mus. Bull. 130, p. 292, 1925.—A. O. U. check-list of North American birds, ed. 4, p. 36, 1931.—PETERS, Check-list of the birds of the world, vol. 1, p. 144, 1931.

Brooks saw two pairs of swans flying past the southeast point of St. Lawrence Island on June 28, 1913. Bailey writes that a resident teacher on the island, "Mr. Dupertius, of the Bureau of Education, showed me a photograph which he had made of four young downy swans in their nest on St. Lawrence Island during the summer of 1922. He tells me the species breeds there regularly."

The members of the Harriman Expedition also saw a couple of swans on the island (at a distance the large white objects were first identified as polar bears), and later in the same day they found a pair with young, feeding in a slough. One downy young one was collected.

Collins noted the presence of swans on the island in the summer of 1930 but was unable to obtain a specimen.

PHILACTE CANAGICA (Sevastianoff)

EMPEROR GOOSE

Anas canagicus SEVASTIANOFF, Nova Acta Acad. Sci. Imp. Petropol., vol. 13, p. 349, pl. 10, 1802 [probably Kanaga (or Kyktak) Island, Aleutian Islands].

Philacte canagica, NELSON, Birds of Bering Sea, etc., Cruise of the *Corwin*, p. 95, 1883.—TURNER, Contr. Nat. Hist. Alaska, no. 11, p. 142, 1886.—NELSON, Report upon natural history collections made in Alaska, p. 89, 1887.—NELSON, Bird-Lore, vol. 15, p. 129, 1913.—BROOKS, Bull. Mus. Comp. Zool., vol. 59, p. 389, 1915.—HERSEY, Smithsonian Misc. Coll., vol. 63, no. 2, p. 22, 1916.—BAILEY, Condor, vol. 27, p. 205, 1925.—BENT, U. S. Nat. Mus. Bull. 130, p. 268, 1925.—JAKUES, Auk, vol. 47, p. 364, 1930.—A. O. U. check-list of North American birds, ed. 4, p. 39, 1931.—PETERS, Check-list of the birds of the world, vol. 1, p. 149, 1931.

Anser canagicus, HARTERT, Die Vögel der paläarktischen Fauna, vol. 2, p. 1290, 1920.

The emperor goose is one of the most notable birds of St. Lawrence Island, breeding there in large numbers, especially in the lagoon and lake area in the southern part of the island. Nelson saw great numbers of them along the southwestern coast. Brooks noted them abundantly, during the latter part of June, "flying to and from a marsh by a large lagoon." Hersey was "told repeatedly that emperor geese occur in large numbers on the south side of St. Lawrence Island during the period when engaged in the postnuptial moult, and" he believes "that the center of their abundance to-day is on this island." Bailey writes that Hendee saw this species daily during the first week in July.

He was working the north shore, which, according to the natives, is not a good locality for this species, the lagoons along the southern side being the main breeding ground. * * * St. Lawrence Island has been considered the

center of abundance of the emperor goose, but from my experience I believe the southern shore of Kotzebue Sound to be their favorite breeding ground.

Dixon¹² found these geese to be very numerous on the island. On June 25 he saw flocks of from 7 to 20. He saw in all more than 100 birds, but none of those dissected showed signs of breeding, and he found no recent nests.

Collins procured two adults and two fully grown immature birds with dark heads. The latter two, a male and a female, were shot on September 21; an adult male was taken on September 18; and an unsexed adult on October 2. All are in rather fresh plumage. All were collected at Gambell.

The immature male has a little more white on the postero-median portion of the abdomen than the female of corresponding age.

ANSER ALBIFRONS ALBIFRONS (Scopoli)

WHITE-FRONTED GOOSE

Branta albifrons SCOPOLI, Annus I Historico-Naturalis, p. 69, 1769 (no locality given=Carniola).

Anser albifrons gambeli, NELSON, Report upon natural history collections made in Alaska, p. 83, 1887.

Nelson writes that during the summer of 1881 a number of these geese were found feeding on St. Lawrence Island.

Collins tells me that he saw some grayish geese there during the summer of 1930, but was unable to shoot one.

MARECA PENELOPE (Linnaeus)

EUROPEAN WIDGEON

Anas penelope LINNAEUS, Systema naturae, ed. 10, vol. 1, p. 126, 1758 (Europe; restricted type locality, Sweden).

Collins brought back an unsexed, undated bird, taken at Gambell. By plumage it is a female and is clearly referable to *penelope* and not to *americana*, as it has a very rufous-brown head, and abundantly gray-freckled axillars.

This duck has not been recorded previously from St. Lawrence Island.

DAFLA ACUTA TZITZIOHOA (Vieillot)

AMERICAN PINTAIL

Anas tzitziohoa VIEILLOT, Nouv. Dict. d'Hist. Nat., vol. 5, p. 163, 1816 (Mexique).

Dafla acuta NELSON, Birds of Bering Sea, etc., Cruise of the *Corwin*, p. 96, 1883; Report upon natural history collections made in Alaska, p. 69, 1887.

Anas acuta tzitziohoa, PHILLIPS, Natural history of the ducks, vol. 2, p. 308, 1923.

Nelson saw several pintails on St. Lawrence Island in the summer of 1881, but apparently he did not collect any. Collins obtained one immature male at Gambell in August. It is quite impossible to

¹² Auk, vol. 33, p. 373, 1916.

determine the subspecific identity of such a specimen satisfactorily, but Phillips considers St. Lawrence Island as within the breeding range of the American race *tzitzihoo*, with which I have identified Collins's bird. It has the broad speculum supposed to be characteristic of *tzitzihoo*.

NYROCA MARILA (Linnaeus)

GREATER SCAUP DUCK

Anas Marila LINNAEUS, Fauna Suecica, ed. 2, p. 39, 1761 (in Lapponia=Lapland).

Fulix marila, NELSON, Birds of Bering Sea, etc., Cruise of the *Corwin*, p. 97, 1883.

Nelson states that this duck occurs on St. Lawrence Island. Beyond this bare statement nothing seems to be known of it as a member of the avifauna of that island.

CLANGULA HYEMALIS (Linnaeus)

OLD-SQUAW

Anas hyemalis LINNAEUS, Systema naturae, ed. 10, vol. 1, p. 126, 1758 (in Europa et America arctica=northern provinces of Sweden).

Harelda glacialis, NELSON, Birds of Bering Sea, etc., Cruise of the *Corwin*, p. 99, 1883.

Harelda hyemalis, BROOKS, Bull. Mus. Comp. Zool., vol. 59, p. 392, 1915.

Clangula hyemalis, BAILEY, Condor, vol. 27, p. 170, 1925.—PHILLIPS, Natural history of the ducks, vol. 3, p. 350, 1925.

Nelson saw old-squaws about St. Lawrence Island during his visit there in June and July, 1881. Brooks found them very common, in pairs and small flocks, on June 2. He notes that when "paired, the female very often flies ahead of the male, as does the female eider. A set of six fresh eggs was taken at St. Lawrence Island, June 25, 1913." Bailey obtained a set of five eggs there on July 9. While on the island with the other naturalists of the Harriman Expedition on July 13, 1899, Dr. A. K. Fisher obtained a specimen of this duck.

Collins obtained a male at Gambell in August and a female there on October 17. Both birds are in a molting condition.

HISTRIONICUS HISTRIONICUS PACIFICUS Brooks

WESTERN HARLEQUIN DUCK

Histrionicus histrionicus pacificus BROOKS, Bull. Mus. Comp. Zool., vol. 59, no. 5, p. 393, Sept., 1915 (Cape Shipunski, Kamchatka).

Histrionicus histrionicus, HERSEY, Smithsonian Misc. Coll., vol. 66, no. 2, p. 18, 1916.

Histrionicus histrionicus pacificus, BAILEY, Condor, Vol. 27, p. 197, 1925.—BENT, U. S. Nat. Mus. Bull. 130, p. 62, 1925.

Nelson¹³ does not definitely list this duck from St. Lawrence Island, but states that it is found on "the shores and islands of Bering Sea." Hersey saw a few to the east of St. Lawrence Island, and Bailey saw three birds on the island on June 28.

Collins obtained a female at Gambell on June 27, and an unsexed bird, probably also a female, on October 2. The June specimen is in molt.

According to Bent, this duck probably breeds on St. Lawrence Island.

POLYSTICTA STELLERI (Pallas)

STELLER'S EIDER

Anas stelleri PALLAS, Spicilegia zoologica, etc., vol. 1, fasc. 6, p. 35, pl. v, 1769 (east Kamchatka).

Polysticta stelleri, NELSON, Birds of Bering Sea, etc., Cruise of the *Corwin*, p. 99, 1883.—BROOKS, Bull. Mus. Comp. Zool., vol. 59, p. 395, 1915.—HERSEY, Smithsonian Misc. Coll., vol. 66, no. 2, p. 19, 1916.—BENT, U. S. Nat. Mus. Bull. 130, p. 73, 1925.—A. O. U. check-list of North American birds, ed. 4, p. 55, 1931.

Eniconetta stelleri, NELSON, Report upon natural history collections made in Alaska, p. 75, 1887.

Nelson found Steller's eider evidently breeding in small numbers around the first of July in the brackish ponds on St. Lawrence Island.

Brooks found a number of large flocks on the south side of the island on June 25. These flocks consisted mostly of males. Hersey found them common on the island also.

Bailey¹⁴ definitely states that Hendee saw none of these birds during his week's stay on the island.

Collins collected an adult male in breeding plumage on June 8 at Gambell. The black of the back, rump, and upper tail coverts has relatively little of the violaceous sheen as compared with other specimens from Alaska. The blackish chin and throat patch are broadly connected posteriorly with the dark collar. The width of the connection appears to be very variable; in some specimens it is reduced to a very fine line, in others (as in the present case) it is as much as 12 millimeters wide.

SOMATERIA V-NIGRA Gray

PACIFIC EIDER

Somateria v-nigra GRAY, Proc. Zool. Soc. London, 1855, p. 212, pl. 107, Feb., 1856 (Kotzebue Sound [Alaska]).

Somateria v-nigra, BROOKS, Bull. Mus. Comp. Zool., vol. 59, p. 396, 1915.—BAILEY, Condor, vol. 27, p. 200, 1925.

¹³ Birds of Bering Sea and the Arctic Ocean. Cruise of the *Corwin* in Alaska and the NW. Arctic Ocean in 1881, p. 98, 1883.

¹⁴ Condor, vol. 27, p. 197, 1925.

Nelson¹⁵ writes that this eider is found everywhere about the shores and islands of Bering Sea, but gives no definite mention of St. Lawrence Island. Brooks found the species common in pairs early in June. Bailey writes that "great flocks of them were seen along the edge of the ice * * * from King Island to St. Lawrence Island."

Collins obtained a third-grown juvenal female on September 21; three adult males, all in molt, on September 27, October 11, and October 20; and four adult females, June 1, October 12, and October 20. The last four show a great deal of variation in coloration; the two October birds are in fresh plumage, the June bird and one without date are in worn condition.

The juvenal bird is in natal down, with the first pennaceous feathering just beginning to show on the wings, tail, breast, and belly.

The adult males taken on September 27 and October 11 have brownish heads, necks, and breasts; the one shot on October 20 has the head largely white with the heavy black crown patch, and has a white neck and breast, scapulars, and interscapulars.

According to Phillips,¹⁶ the males begin to molt into the eclipse plumage, illustrated by the three specimens discussed above, soon after the first of July, and this plumage is often retained in part until November.

When on St. Lawrence Island on July 13, 1899, the Harriman Expedition saw a few of these ducks, but did not collect any. It would be interesting to know how early the postnuptial molt begins on that island.

SOMATERIA SPECTABILIS (Linnaeus)

KING EIDER

Anas spectabilis LINNAEUS, Systema naturae, ed. 10, vol. 1, p. 123, 1758 (in Canada, Svecia=Sweden).

Somateria spectabilis, NELSON, Report upon natural history collections made in Alaska, p. 79, 1887.—BROOKS, Bull. Mus. Comp. Zool., vol. 59, p. 395, 1915.—HERSEY, Smithsonian Misc. Coll., vol. 66, no. 2, p. 20, 1916.—BENT, U. S. Nat. Mus. Bull. 130, p. 113, 1925.—PHILLIPS, Natural history of the ducks, vol. 4, p. 117, 1926.—A. O. U. check-list of North American birds, ed. 4, p. 57, 1931.—PETERS, Check-list of the birds of the world, vol. 1, p. 180, 1931.

Nelson reported king eiders as being common on St. Lawrence Island; Brooks found them numerous about Cape Chibukak, in pairs and small flocks, on June 2; Hersey writes that "during the summer the king eider occurs regularly as far south as St. Lawrence Island where they doubtless breed * * *." According to Phillips,

¹⁵ Birds of Bering Sea and the Arctic Ocean. Cruise of the revenue-steamer *Corwin* in Alaska and the NW. Arctic Ocean in 1881, p. 101, 1883.

¹⁶ Natural history of the ducks, vol. 4, p. 83, 1926.

William Percy also recorded this eider from St. Lawrence, but I am not aware of this being published elsewhere.

Collins obtained two adult males, one on June 1, the other without date. Both were shot near Gambell, and both are in fine, breeding plumage.

ARCTONETTA FISCHERI (Brandt)

SPECTACLED EIDER

Fuligula Fischeri BRANDT, *Fuligulam Fischeri novam avium speciem*, pp. 10, 14, 1 pl., 1847 (St. Michael, Alaska).

Arctonetta fischeri, BROOKS, *Bull. Mus. Comp. Zool.*, vol. 59, p. 395, 1915.—

HERSEY, *Smithsonian Misc. Coll.*, vol. 66, no. 2, p. 19, 1916.

Brooks collected three specimens of the spectacled eider from a small flock on the south shore of St. Lawrence Island, on June 25, 1913. Hersey observed this species in small numbers, apparently on the north side of the island.

OIDEZIA AMERICANA Swainson

AMERICAN SCOTER

Oidemia americana SWAINSON, in Swainson and Richardson, *Fauna Boreali-Americana*, vol. 2, p. 450, 1831 (1832) (Hudson Bay, latitude 57° N.).

Oedemia americana, NELSON, *Birds of Bering Sea, etc., Cruise of the "Corwin"*, p. 102, 1883.

Oidemia americana, NELSON, *Report upon natural history collections made in Alaska*, p. 80, 1887.

The American scoter occurs sparingly upon St. Lawrence Island. Nelson is the only naturalist who has recorded it there.

MERGUS SERRATOR Linnaeus

RED-BREASTED MERGANSER

Mergus Serrator LINNAEUS, *Systema naturae*, ed. 10, vol. 1, p. 129, 1758 (in Europa=Sweden).

Merganser serrator, NELSON, *Report upon natural history collections made in Alaska*, p. 66, 1887.

Mergus serrator, PHILLIPS, *Natural history of the ducks*, vol. 4, p. 281, 1926.

Nelson found the red-breasted merganser breeding on St. Lawrence Island in the summer of 1881.

Collins collected one unsexed bird (probably a female) at Gambell in September. The specimen is in fairly fresh plumage.

Family GRUIDAE, Cranes

GRUS CANADENSIS CANADENSIS (Linnaeus)

LITTLE BROWN CRANE

Ardea canadensis LINNAEUS, *Systema naturae*, ed. 10, vol. 1, p. 141, 1758 (based on the Brown and Ash-colour'd Crane, Edwards, *Natural history of birds*, p. 133: In America septentrionali=Hudson Bay).

Grus canadensis, NELSON, Report upon natural history collections made in Alaska, p. 95, 1887.—BROOKS, Bull. Mus. Comp. Zool., vol. 59, p. 888, 1915.

Nelson recorded the little brown crane as a summer resident on St. Lawrence Island. Brooks saw two pairs at the southeast end of the island, "where a pair and one juvenile about a week old were taken June 27, 1913."

Collins noted the presence of this bird in the summer of 1930, but he was not able to obtain a specimen.

Family CHARADRIIDAE, Plovers, Turnstones, Surf-birds

CHARADRIUS SEMIPALMATUS Bonaparte

SEMIPALMATED PLOVER

Charadrius semipalmatus BONAPARTE, Journ. Acad. Nat. Sci. Philadelphia, vol.

5, p. 98, 1825 (new name for *Tringa hiaticula* Wilson; coast of New Jersey).

Aegialites semipalmatus, NELSON, Birds of Bering Sea, etc., Cruise of the *Corwin*, pp. 84-85, 1883.

Nelson found this plover on St. Lawrence Island, thereby establishing its place in the known avifauna of the island.

PLUVIALIS DOMINICA FULVA (Gmelin)

PACIFIC GOLDEN PLOVER

Charadrius fulvus GMELIN, Systema naturae, vol. 1, pt. II, p. 687, 1789 (based on the Fulvous Plover, Latham, Synopsis, vol 3, p. 211: In Tahiti maritimis et uliginosis=Society Islands).

Charadrius dominicus, NELSON, Report upon natural history collections made in Alaska, p. 124, 1887.

Charadrius dominicus fulvus, NELSON, Report upon natural history collections made in Alaska, p. 125, 1887.

As was pointed out long ago by Nelson, the relationships of the golden plovers of the Bering Sea coasts and islands are involved, because both *dominica* and *fulva* intergrade there. Nelson examined a long series and decided that on "the Siberian coast of Bering Sea the typical Asiatic form is found common, and is of much rarer occurrence on the Alaskan coast, from the peninsula of Alaska north to Point Barrow. On this stretch of coast to the island of St. Lawrence *dominicus* is the predominating form, but specimens are found grading in a regular series from this bird to the *fulvus* of the Asiatic region * * *."

Bailey,¹⁷ quoting Bangs, states that Wainwright, Alaska, must be close to the meeting ground of the two races.

Collins collected 5 specimens at Gambell—2 males, 2 unsexed, and 1 female—in September. All these birds I refer to *fulva* and not to

¹⁷ Condor, vol. 28, p. 85, 1926.

dominica, although I am not unmindful of the fact that Nelson came to the opposite conclusion. According to Hartert,¹⁸ *fulva* is smaller, having wings 164 to 175 mm. in length, as against 176 to 186 mm. in *dominica*. The wing lengths of the present five birds are as follows: Males, 165, 163; female, 161.5; unsexed, 163, 168 mm. All are, therefore, referable to *fulva* on the basis of size. The present specimens are all very yellow on the upper parts, thereby also agreeing better with *fulva* than with *dominica*. They are all in fresh plumage.

Nelson recorded both races from St. Lawrence Island, but in view of the intermediate nature of the place I feel it would be misleading to claim that there were two forms of golden plover there. It would, perhaps, be more to the point to call all the St. Lawrence birds intermediates between the two subspecies.

ARENARIA INTERPRES INTERPRES (Linnaeus)

EUROPEAN TURNSTONE

Tringa Interpres LINNAEUS, Systema naturae, ed. 10, vol. 1, p. 148, 1758 (in Europa et America septentrionali=Islands of Gothland, Sweden).

Streptilas interpres, NELSON, Birds of Bering Sea, etc., Cruise of the *Corwin*, pp. 82, 83, 1883.

Arenaria interpres, NELSON, Report upon natural history collections made in Alaska, p. 123, 1887.

Arenaria interpres interpres, BAILEY, Condor, vol. 28, pp. 85, 86, 1926.—BENT, U. S. Nat. Mus. Bull. 146, p. 293, 1929.

Nelson saw a number of mated pairs with nests on St. Lawrence Island the last of June, 1881. Bailey writes that a "few turnstones were noted on the gravel beach in the vicinity of Gambel village, on St. Lawrence Island, and Hendee found one downy young, which had left the nest June 29."

As Bailey states, the birds from Cape Halkett and from Wales, Alaska, would have to be considered *A. i. oahuensis* (Bloxham) if that race be recognized. This is probably true also for the St. Lawrence Island birds. The status of *oahuensis* seems doubtful, however.

ARENARIA MELANOCEPHALA (Vigors)

BLACK TURNSTONE

Streptilas melanocephalus VIGORS, Zool. Journ., vol. 4, p. 356, Jan., 1829 (north-west coast of [North] America).

Arenaria melanocephala, NELSON, Report upon natural history collections made in Alaska, p. 129, 1887.

Nelson observed this species sparingly on St. Lawrence Island. No one else has recorded it since.

¹⁸ Die Vögel der paläarktischen Fauna, vol. 2, pp. 1551, 1552, 1920.

Family SCOLOPACIDAE, Snipe, Woodcock, Sandpipers

ARQUATELLA PTILOCNEMIS PTILOCNEMIS (Coues)

PRIBILOF SANDPIPER

- Tringa ptilocnemis* COUES, in Elliott, Report on the Seal Islands of Alaska (not paged), 1873 (St. George Island, Pribilof Islands).
Arquatella ptilocnemis, NELSON, Birds of Bering Sea, etc., Cruise of the *Corwin*, p. 86, 1883.—HANNA, Condor, vol. 23, p. 51, 1921.
Tringa ptilocnemis NELSON, Report upon natural history collections made in Alaska, p. 105, 1887.
Arquatella maritima ptilocnemis, HERSEY, Smithsonian Misc. Coll., vol. 66, no. 2, p. 24, 1916.
Erolia maritima ptilocnemis, HARTERT, Die Vögel der paläarktischen Fauna, vol. 2, p. 1592, 1920.
Arquatella ptilocnemis ptilocnemis, BENT, U. S. Nat. Mus. Bull. 142, pp. 153, 159, 1927.—A. O. U. check-list of North American birds, ed. 4, p. 118, 1931.

Nelson found a single pair of these sandpipers on the south shore of St. Lawrence Island in June, 1881. Hersey saw a few on the north side of the island on July 24, 1914. Hanna overlooked Hersey's note, as he thought there was but a single record for the bird for St. Lawrence Island. He suspected "that the birds have some other extensive breeding ground than St. George, St. Paul, and St. Mathew Islands, because in September and October large flocks came to the two former islands; these appear to contain many more individuals than are in existence on all three. Whether St. Lawrence Island supplies the extra number or not remains for future determination."

The Harriman Expedition obtained one male and two females on July 13, 1899, and Collins got a male at Gambell in September, 1930. The last-mentioned specimen is in an advanced stage of molt. It is a peculiar bird in that it has the darker color of *couesi* and the larger size of *ptilocnemis* (wing length 128 mm.).

ARQUATELLA PTILOCNEMIS COUESI Ridgway

ALEUTIAN SANDPIPER

- Arquatella couesi* RIDGWAY, Bull. Nuttall Orn. Club, vol. 5, p. 160, July, 1880 (Aleutian Islands and coast of Alaska=Attu Island, Aleutian Islands).
Arquatella maritima couesi, BROOKS, Bull. Mus. Comp. Zool., vol. 59, p. 386, 1915.—BAILEY, Condor, vol. 27, p. 236, 1925.
Arquatella ptilocnemis couesi, BENT, U. S. Nat. Mus. Bull. 142, p. 166, 1927.

Brooks noted a few at the southeast end of St. Lawrence Island during June, 1912. He collected specimens, now in the Museum of Comparative Zoölogy, at Cambridge, Mass. Bailey saw several during the first week in July.

St. Lawrence Island appears to be a meeting place of typical *ptilocnemis* and of *couesi*—northern and southern races of the same species, just as it is for the eastern and western forms of the golden plover.

PISOBIA MELANOTOS (Vieillot)

PECTORAL SANDPIPER

Tringa melanotos VIEILLLOT, Nouv. Dict. d'Hist. Nat., nouv. éd., vol. 34, p. 462, 1819 (Paraguay).

Pisobia maculata, BAILEY, Condor, vol. 28, p. 31, 1926.

The only published record for St. Lawrence Island is Bailey's observational one. He saw some pectoral sandpipers there on July 29. The Harriman Expedition, however, obtained a female specimen on the island on July 13, 1899.

PELIDNA ALPINA SAKHALINA (Vieillot)

RED-BACKED SANDPIPER

Scolopax sakhalina VIEILLLOT, Nouv. Dict. d'Hist. Nat., nouv. éd., vol. 3, p. 359, 1816 (en Russie=Sakhalin Island, Okhotsk Sea).

Pelidna alpina americana, NELSON, Birds of Bering Sea, etc., Cruise of the *Corwin*, p. 88, 1883.

Pelidna alpina pacifica; *Pelidna alpina sakhalina*, BAILEY, Condor, vol. 28, p. 33, 1926.

Pelidna alpina sakhalina, BROOKS, Bull. Mus. Comp. Zool. vol. 59, p. 386, 1915.

Nelson found this bird to be common on St. Lawrence Island. The Harriman Expedition obtained three examples on July 13, 1899. Bailey noted several pairs there the first week in July, "where they were no doubt breeding, as specimens we took had their sex organs well developed." Brooks saw, but did not collect, this species, during the latter part of June, 1913.

EREUNETES PUSILLUS (Linnaeus)

SEMI-PALMATED SANDPIPER

Tringa pusilla LINNAEUS, Systema naturae, ed. 12, vol. 1, p. 252, 1766 (based on La Petite Alouette de mer de S. Domingue. *Cinclus Dominicensis minor*, Brisson, Ornithologie, vol. 5, p. 222: In Domingo=Santo Domingo, West Indies).

Ereunetes pusillus, NELSON, Birds of Bering Sea, etc., Cruise of the *Corwin*, p. 88, 1883.

According to Nelson, the semipalmated sandpiper is a common summer resident on St. Lawrence Island.

EREUNETES MAURII Cabanis

WESTERN SANDPIPER

Ereunetes Mauri CABANIS, Journ. f. Orn., Nov., 1856, p. 419, 1857 (Cuba).

Ereunetes occidentalis, NELSON, Report upon natural history collections made in Alaska, p. 114, 1887.

Nelson writes that, although this species "is not recorded from the Seal and Aleutian Islands, I have seen the bird at St. Lawrence Island."

LIMOSA LAPPONICA BAUERI Naumann

PACIFIC GODWIT

Limosa Baueri NAUMANN, Naturgeschichte der Vögel Deutschlands, vol. 8, p. 429, 1836 (Neuholland=Australia).

Collins obtained two immature males at Gambell, on August 1 and 23, respectively. These constitute the first records for this species for St. Lawrence Island. They have short bills—culmen lengths of 61 and 63 mm., as against 76 to 120 mm. in the adults. They have darker, less whitish, rump feathers than a bird of corresponding age from Cape Bolskoi Baranov, eastern Siberia.

Family PHALAROPODIDAE, Phalaropes

PHALAROPUS FULICARIUS (Linnaeus)

RED PHALAROPE

Tringa Fulicaria LINNAEUS, Systema naturae, ed. 10, vol. 1, p. 148, 1758 (based on the Red Coot-footed Tringa, Edwards, Natural history of birds, p. 142: In America=Hudson Bay).

Crymophilus fulicarius, NELSON, Report upon natural history collections made in Alaska, p. 98, 1887.

Phalaropus fulicarius NELSON, Birds of Bering Sea, etc., p. 91, 1883.—BROOKS, Bull. Mus. Comp. Zool., vol. 59, p. 387, 1915.—BAILEY, Condor, vol. 27, p. 233, 1925.—BENT, U. S. Nat. Mus. Bull. 142, p. 14, 1927.

Nelson found this bird nesting on St. Lawrence Island. Brooks recorded it as common east of Cape Chibukak, June 24, on the south side of the island, June 25, and at the southeastern end on June 27, 1913. Bailey saw these birds on the island, and Hendee found a nest with two eggs there on July 1.

The Harriman Expedition obtained two males and saw a number of others about some sloughs on the island.

Collins collected a male in breeding plumage on July 24, and two males in winter plumage on October 1 and 7; all were taken at Gambell.

LOBIPES LOBATUS (Linnaeus)

NORTHERN PHALAROPE

Tringa tobata LINNAEUS, Systema naturae, ed. 10, vol. 1, p. 148, 1758 (*lobata* in Emendanda, p. 824) (based on the Cock Coot-footed Tringa, Edwards, Natural history of birds, p. 143: In America septentrionali, Lapponia=Hudson Bay).

Lobipes hyperboreus, NELSON, Birds of Bering Sea, etc., Cruise of the *Corwin*, p. 91, 1883.

Lobipes lobatus, BROOKS, Bull. Mus. Comp. Zool., vol. 59, p. 387, 1915.

In discussing the distribution of the phalaropes in Bering Sea, Nelson states that "the Northern Phalarope appears to be the only species breeding in the Aleutian chain and thence north to St. Lawrence Island, where the Red Phalarope nests." Brooks found the northern phalarope quite common at the southeast end of the island on June 27. On June 26 he collected a clutch of eggs about one-quarter incubated.

Family STERCORARIIDAE, Skuas, Jaegers

STERCORARIUS POMARINUS (Temminck)

POMARINE JAEGER

Lestris pomarinus TEMMINCK, Manuel d'ornithologie, p. 514, 1815 (1814) (les régions du cercle arctique, accidentel sur les côtes de Hollande et de France).

Dr. A. K. Fisher informs me that when he was on St. Lawrence Island with the Harriman Expedition, on July 13, 1899, he saw several pomarine jaegers flying over the tundra in the manner of marsh hawks. He suggests that they were probably after meadow mice, as these mammals were found in stomachs of specimens taken in other localities.

Collins collected two females in the light phase, on July 10 and August 6, respectively, and one unsexed, undated bird in the dark phase; all were shot at Gambell. All three are in good, fairly fresh plumage.

STERCORARIUS PARASITICUS (Linnaeus)

PARASITIC JAEGER

Larus parasiticus LINNAEUS, Systema naturae, ed. 10, vol. 1, p. 136, 1758 (intra tropicum Cancræ, Europæ, Americae, Asiae=coast of Sweden).

Stercorarius parasiticus, NELSON, Birds of Bering Sea, etc., Cruise of the *Corwin*, p. 111, 1883.—SEALE, Proc. Acad. Nat. Sci. Philadelphia, 1898, p. 130.—BAILEY, Condor, vol. 27, p. 101, 1925.

Nelson saw the parasitic jaeger at St. Lawrence Island, as did also Seale on July 1, 1896, and Hendee during the first week in July, 1921.

STERCORARIUS LONGICAUDUS Vieillot

LONG-TAILED JAEGER

Stercorarius longicaudus VIEILLOT, Nouv. Dict. d'Hist. Nat., nouv. éd., vol. 32, p. 157, 1819 (le nord de l'Europe, de l'Asie et de l'Amerique).

Stercorarius longicaudus, BENT, U. S. Nat. Mus. Bull. 113, p. 28, 1921.—BAILEY, Condor, vol. 27, p. 102, 1925.

Bent records this bird as breeding on St. Lawrence Island. Hendee saw several there during the first week in July.

Family LARIDAE, Gulls, Terns

LARUS HYPERBOREUS GUNNERUS

GLAUCOUS GULL

Larus hyperboreus GUNNERUS, in Leem, Beskrivelse over Finmarkens Lapper, p. 226 (note), 1767 (northern Norway).

Larus barrovianus, NELSON, Report upon natural history collections made in Alaska, p. 52, 1887.

Larus hyperboreus, JAKUES, Auk, vol. 47, p. 358, 1930.

In his report on the birds of Bering Sea¹⁹ Nelson writes of this gull (under the name *Larus glaucus*) to the effect that it breeds on all the islands and shores of Bering Sea. In his later report he gives the first definite record for St. Lawrence Island and states that the bird breeds in that place.

Dr. A. K. Fisher informs me that one specimen of this gull was secured by the Harriman Expedition and that others were seen the day they landed on St. Lawrence Island (July 13, 1899).

Jaques noted these birds north of the island, but none "were seen much south of St. Lawrence Island."

LARUS GLAUDESCENS Naumann

GLAUCOUS-WINGED GULL

Larus glaucescens NAUMANN, Naturgeschichte der Vögel Deutschlands, vol. 10, p. 351, 1840 (Nord-Amerika).

Larus glaucescens, BROOKS, Bull. Mus. Comp. Zoöl., vol. 59, p. 373, 1915.—RIDGWAY, U. S. Nat. Mus. Bull. 50, vol. 8, p. 598, 1919.—BENT, U. S. Nat. Mus. Bull. 113, p. 73, 1921.—HARTERT, Die Vögel der paläarktischen Fauna, vol. 2, p. 1734, 1921.

Brooks found this species breeding at St. Lawrence Island. A set of eggs taken by him on June 20 was very advanced in incubation.

LARUS ARGENTATUS VEGAE Palmén

VEGA GULL

Larus argentatus BRÜNN. var. *Vegae* PALMÉN, in Nordenskiöld, Vega-Expeditionens Vetenskapliga Iakttagelser, vol. 5, p. 370, 1887 (Pidlin and vicinity, extreme northeastern Siberia).

Collins collected two Vega gulls, thereby adding this species to the known avifauna of St. Lawrence Island. Both birds were taken

¹⁹ Nelson, E. W., Birds of Bering Sea and the Arctic Ocean. Cruise of the revenue-steamer *Corwin* in Alaska and the NW. Arctic Ocean in 1881, p. 106, 1883.

at Gambell; unfortunately both are without further data. Both are in worn plumage, and both have a little black on the rectrices. One bird is otherwise in full adult plumage; the other has a considerable number of darkish markings on the head.

RISSA TRIDACTYLA POLLICARIS Ridgway

PACIFIC KITTIWAKE

Rissa tridactyla pollicaris STEJNEGER MS., RIDGWAY, in Baird, Brewer, and Ridgway, Water birds of North America, vol. 2, p. 202, 1884 (Kotzebue Sound, Alaska).

Rissa tridactyla kotzebuei, NELSON, Birds of Bering Sea, etc., Cruise of the *Corwin*, p. 105, 1883.

Rissa tridactyla pollicaris, SEALE, Proc. Acad. Nat. Sci. Philadelphia, 1898, p. 131.—BAILEY, Condor, vol. 27, pp. 103, 104, 1925.—JAKUES, Auk, vol. 47, p. 358, 1930.

Nelson found these kittiwakes about the shores of St. Lawrence Island during the last days of June, 1881. Bailey found them "to be abundant * * * at St. Lawrence Island, where they were already nesting. I saw many of their eggs along the cliffs below Sivunga on July 8." Seale saw great numbers of these birds.

Hersey²⁰ saw kittiwakes on the high cliffs near Gambell. Jaques found the species common at sea near St. Lawrence Island.

Collins collected seven specimens, all at Gambell, during October. Most of the birds are unsexed. Four of them have the tail terminally banded with black, a considerable extent of black on the hind neck, interscapulars, and upper wing coverts, and black bills, and are obviously young birds. The other three are adults with pale yellow bills. The young birds are in fairly fresh plumage; the adults are abraded.

XEMA SABINI (Sabine)

SABINE'S GULL

Larus sabini J. SABINE, Trans. Linn. Soc. London, vol. 12, pt. ii, p. 522, pl. 29, 1819 (west coast of Greenland, latitude 75° 29', longitude 60° 9', Sabine Islands, near Melville Bay).

Xema sabinet, NELSON, Birds of Bering Sea, etc., Cruise of the *Corwin*, p. 109, 1883.

Xema sabini, NELSON, Report upon natural history collections made in Alaska, p. 56, 1887.

Xema sabini, BENT, U. S. Nat. Mus. Bull. 113, p. 196, 1921.—DWIGHT, Bull. Amer. Mus. Nat. Hist., vol. 52, p. 328, 1925.

Nelson notes that Sabine's gull occurs "in small numbers off St. Lawrence Island, but is unknown from the other Bering Sea islands." Bent writes that this gull breeds on St. Lawrence Island.

²⁰ Smithsonian Misc. Coll., vol. 66, no. 2, p. 4, 1916.

Collins obtained four adults and one young of this species, all at Gambell, in July and August (two of the specimens are undated).

The July adult is in very fresh plumage; the two taken in August are somewhat worn. The abrasion on the primaries is of interest in that the white tips wear off more quickly laterally than terminally, leaving the feathers with a narrow white terminal bar from which protrudes, distally, a slender white shaft with a few white barbs on either side. Finally this protruding part also wears off. One of the adults (undated) has the outer greater upper primary coverts tipped with white; the others have no white on these feathers. The young bird is in fresh plumage (undated).

STERNA PARADISEA Brünnich

ARCTIC TERN

Sterna Paradisaea BRÜNNICH, Ornithologia Borealis, p. 46, 1764 (E Christiansøe=Christiansøe Island, Denmark).

Sterna paradisaea, NELSON, Report upon natural history collections made in Alaska, p. 58, 1887.—BROOKS, Bull. Mus. Comp. Zool., vol. 59, p. 372, 1915.—BAILEY, Condor, vol. 27, p. 164, 1925.

Nelson writes that the arctic tern "occurs on St. Lawrence and St. Matthew's Islands, where it breeds."

Brooks found a colony of some 25 pairs breeding "on a sand spit in the large lagoon on the south side of St. Lawrence Island in June, 1913. Several sets of eggs taken June 25 showed that incubation had started." Bailey saw several daily during the latter part of June and early part of July.

Collins collected a female at Gambell on August 21. It is in an advanced stage of molt and appears to be a young bird coming into adult plumage.

Family ALCIDAE, Auks, Murres, Auklets

URIA LOMVIA ARRA (Pallas)

PALLAS'S MURRE

Cephus Arra PALLAS, Zoographia Rosso-Asiatica, vol. 2, p. 347, 1811 (in oceano orientali circa Camtschatcam).

Uria lomvia arra, NELSON, Report upon natural history collections made in Alaska, p. 45, 1887.—SEALE, Proc. Acad. Nat. Sci. Philadelphia, p. 130, 1898.—HERSEY, Smithsonian Misc. Coll., vol. 66, no. 2, p. 10, 1916.—BAILEY, Condor, vol. 27, p. 66, 1925.

Nelson saw large numbers of these murres off St. Lawrence Island. Hersey found the species breeding on the cliffs behind Gambell, and Bailey records that Hendee found them extremely numerous on the island during the first week in July. They were then just beginning to nest, and ravens and kittiwakes were seen flying off with their eggs.

Seale wrote that "off St. Lawrence Island July 1 murres were far more abundant than any other species of bird."

Collins obtained a male on June 1, a female on August 6 and another on August 10, and still another on September 4. All were collected at Gambell. All are adults.

CEPPHUS GRYLLE MANDTI (Mandt)

MANDT'S GUILLEMOT

Uria mandtii Licht., MANDT, Observationes in historiam naturalem et anatomiam comparatam in itinere Groenlandico factae, p. 30, 1822 (Spitzbergen).

Collins collected a young male at Gambell, on November 23, 1930. It is in fairly fresh plumage. This is the only St. Lawrence record I know of.

CEPPHUS COLUMBA Pallas

PIGEON GUILLEMOT

Cephus Columba PALLAS, Zoographia Rosso-Asiatica, vol. 2, p. 348, 1811 (in oceano arctico pariterque circa Camtschatcam et in omni freto inter Sibiriam et Americam=Bering Sea).

Cephus columba, BAILEY, Condor, vol. 27, p. 66, 1925.

Bailey found the pigeon guillemot to be abundant on St. Lawrence Island, nesting along the cliffs near Sevunga and below Gambell. It is strange that Nelson, Brooks, and others overlooked this bird if it is really abundant.

Collins collected an adult male on July 14 and another, both in breeding plumage, on August 16 and a young bird on October 11, all at Gambell. The August bird is very much abraded.

CYCLORRHYNCHUS PSITTACULA (Pallas)

PAROQUET AUKLET

Alca psittacula PALLAS, Spicilegia zoologica, etc., vol. 1, fasc. 5, p. 13, pls. II, v, figs. 4-6, 1769 (insulas partim versus laponiam partim versus Americam septentrionalem sparsus=Kamchatka).

Cyclorhynchus psittaculus, NELSON, Report upon natural history collections made in Alaska, pp. 40, 41, 1887.

Phalaris psittacula, HERSEY, Smithsonian Misc. Coll., vol. 66, no. 2, p. 9, 1916.—RIDGWAY, U. S. Nat. Mus. Bull. 50, vol. 8, p. 765, 1919.—BAILEY, Condor, vol. 27, p. 63, 1925.

Nelson found this peculiar auklet abundant on St. Lawrence Island. Hersey noted that this species appeared to be less numerous than the crested auklet or the least auklet.

Bailey writes that there "is a large nesting colony of sea birds below Gambell village on the southwest (northwest) side of St. Law-

rence Island, which Hendee visited, and he reported a number of this species * * * which were nesting, or preparing to nest, among the gigantic boulders * * *. I visited a fine colony of birds near the reindeer-herding camps of Sivunga, on the north shore of St. Lawrence Island, about 60 miles from Gambell. * * * this species of auklet seemed to prefer burrows near the top of the cliff where they could not be molested. The Paroquet Auklets were quite tame and often peered inquisitively at us, even after the murre, cormorants, and other auklets had taken wing."

Collins collected a female at Gambell on July 1. The bird is in fresh plumage and is fully adult.

AETHIA CRISTATELLA (Pallas)

CRESTED AUKLET

Alca cristatella PALLAS, *Spicilegia zoologica*, etc., vol. 1, fasc. 5, p. 18, pls. iii, v, figs. 7-9, 1769 (ultimarum versus Japoniam insularum maxime incola et circa insulam Matney=Yesso, Japan, to Kamchatka).

Simorhynchus cristatellus, NELSON, Report upon natural history collections made in Alaska, pp. 41, 42, 1887.

Aethia cristatella, TOWNSEND, *Bird-Lore*, vol. 15, p. 134, 1913.—BROOKS, *Bull. Mus. Comp. Zool.*, vol. 59, p. 370, 1915.—HERSEY, *Smithsonian Misc. Coll.*, vol. 66, no. 2, p. 9, 1916.—BAILEY, *Condor*, vol. 27, p. 64, 1925.

Nelson found the crested auklet extremely numerous among the ice off St. Lawrence Island. Brooks found it common at Cape Chibukak on June 3; Hersey noted its abundance near Gambell, July 24 and 25. Bailey writes that on "St. Lawrence Island, these birds were present with the other auklets in both the colonies * * *. The summits of the cliffs were lined with a confused jumble of boulders among which this species and the least auklets made their homes."

Collins collected 10 specimens, all at Gambell. The six with dates were taken late in June and in July and August. One unsexed specimen has the bill as in the winter condition, that is, it has shed the nasal and suprarictal cuirass.

AETHIA PUSILLA (Pallas)

LEAST AUKLET

Uria pusilla PALLAS, *Zoographia Rosso-Asiatica*, vol. 2, p. 373, 1811 (circa Camtschatcam).

Cerorhinca occidentalis?, VIGORS, *The zoology of Captain Beechey's voyage to the Pacific and Behring's Strait. Ornithology*, p. 34, 1839.

Simorhynchus pusillus, NELSON, Report upon natural history collections made in Alaska, p. 43, 1887.

Aethia pusilla, BROOKS, Bull. Mus. Comp. Zool., vol. 59, p. 371, 1915.—HERSEY, Smithsonian Misc. Coll., vol. 6, no. 2, p. 9, 1916.—HARTERT, Die Vögel der paläarktischen Fauna, vol. 8, p. 1787, 1921.—BAILEY, Condor, vol. 27, p. 64, 1925.

Oiceronia pusilla, RIDGWAY, U. S. Nat. Mus. Bull. 50, vol. 8, p. 788, 1919.

Finsch²¹ discussed the unpublished copper plates of J. F. v. Brandt's work for the *Icones Avium Rossicarum*, and identified the figures and their names and localities. Figures 6 and 7 on plate VI are given on page 21 as follows: "6.7. *Phaleris pygmaea-Simorhynchus pusillus* (Pall.)—St. Lorenz." On page 81, however, under the account of *Simorhynchus pusillus*, no mention is made of St. Lawrence Island. It is doubtful if Brandt's figure was drawn from a bird from St. Lawrence Island.

Vigors states that "specimens of these birds were brought off from St. Lawrence Island in great abundance." Nelson found the species abundant there and so did Hersey, Brooks, and Bailey. Thus, Brooks found "them in enormous numbers at St. Lawrence Island." Bailey writes that this species "is the most abundant of the auklets * * *. At St. Lawrence Island we saw thousands of them in the breeding colony at Sivunga, where they were preparing to nest among the rocks and rounded boulders."

Collins collected a male and a female at Gambell in July. Both are in somewhat worn plumage.

AETHIA PYGMAEA (Gmelin)

WHISKERED AUKLET

Alca pygmaea GMELIN, *Systema naturae*, vol. 1, pt. ii, p. 555, 1789 (based on the Pygmy Auk, Pennant, *Arctic zoology*, vol. 2, p. 513: *Circa insulam avium inter Asiam septentrionalem et Americam*=Islands in Bering Sea).

Mormon cristatellus (not *Alca cristatella* Pallas, 1769), CUVIER, in Choris's *Voyage pittoresque autour du monde*, Îles Aléoutiennes, p. 20, pl. 12, 1882.

Alcella pygmaea, RIDGWAY, U. S. Nat. Mus. Bull. 50, vol. 8, p. 772, 1919.

M. Choris received specimens of the whiskered auklet from the natives of St. Lawrence Island. Ridgway considers Cuvier's name, based on one of Choris's specimens, as a synonym of *pygmaea*, but he appears to consider the locality open to question.

FRATERCULA CORNICULATA (Naumann)

HORNED PUFFIN

Mormon corniculata NAUMANN, *Isis*, vol. 9, Band ii, Heft 8, col. 782 (pl. vii, figs. 3, 4), 1821 (Kamchatka).

Fratercula corniculata, TURNER, *Contr. Nat. Hist. Alaska*, no. 11, p. 119, 1886.—BENT, U. S. Nat. Mus. Bull. 107, p. 103, 1919.—BAILEY, *Condor*, vol. 27, p. 62, 1925.

²¹ Abh. Naturw. Ver. Bremen, vol. 1, 1872.



ESKIMO NETTING AUKLETS NEAR GAMBELL

The least and crested auklets are the species caught most frequently.

Turner listed the horned puffin as a breeding bird on St. Lawrence Island. Bailey found it "very abundant at King and St. Lawrence Islands on June 27 and 28, doubtless then beginning to lay. * * * They were even more abundant at St. Lawrence Island along the cliffs on the north side, and in the colonies on the southwest (north-west?) near Gambell village."

Collins collected six adults of both sexes at Gambell in August and September.

LUNDA CIRRHATA (Pallas)

TUFTED PUFFIN

Alca cirrhata PALLAS, *Spicilegia zoologica*, etc., vol. 1, fasc. v, p. 7, pls. i, v, figs. 1-3, 1769 (in mari inter Kamtschatcam et Americam Archipelagumque Kurilum=Bering Sea).

Lunda cirrhata, TURNER, *Contr. Nat. Hist. Alaska*, no. 11, p. 117, 1886.—BAILEY, *Condor*, vol. 27, p. 62, 1925.

Turner first recorded the tufted puffin from St. Lawrence Island. Bailey found it fairly common there, as did Collins, who collected four adults at Gambell late in June and in August.

Family CUCULIDAE, Cuckoos

CUCULUS CANORUS BAKERI Hartert

Cuculus canorus bakeri HARTERT, *Die Vögel der paläarktischen Fauna*, vol. 2, p. 948, 1912 (Shillong, Khasia Hills).

Cuculus canorus bakeri, FRIEDMANN and RILEY, *Auk*, vol. 48, p. 269, 1931.—A. O. U. check-list of North American birds, ed. 4, p. 159, 1931.

An adult female, obtained by Collins at Gambell on July 1, 1930, is the only record, not only for St. Lawrence Island but for the entire Nearctic realm, for this dark form of the European cuckoo.

Family STRIGIDAE, Owls

NYCTEA NYCTEA (Linnaeus)

SNOWY OWL

Strix Nyctea LINNAEUS, *Systema naturae*, ed. 10, vol. 1, p. 93, 1758 (in Europa et America septentrionali=Sweden).

Collins obtained two males at Gambell, one on September 18 and the other on October 2. The latter is almost immaculately white underneath and has only a very few brownish marks on the tertials and rectrices; the former specimen is more abundantly marked with dark brown.

The snowy owl does not seem to have been recorded from St. Lawrence Island before.

Family CORVIDAE, Crows, Magpies, Jays

CORVUS CORAX PRINCIPALIS Ridgway

NORTHERN RAVEN

Corvus corax principalis RIDGWAY, Manual of North American birds, p. 361, 1887 (Greenland to Alaska, etc.=St. Michael, Alaska).

Corvus corax sinuatus, NELSON, Report upon natural history collections made in Alaska, p. 165, 1887.

Corvus corax principalis, BAILEY, Condor, vol. 28, p. 165, 1926.

Nelson and Elliott both saw ravens on St. Lawrence Island. Bailey writes that a few were "seen daily by Hendee on St. Lawrence Island, where they were preying upon the cliff-nesting birds." He saw some there himself as well.

Collins found this bird breeding quite commonly on the island and procured an adult female at Gambell on August 16. (Pl. 4.)

Family MOTACILLIDAE, Wagtails, Pipits

BUDYTES FLAVUS ALASCENSIS Ridgway

ALASKA YELLOW WAGTAIL

Budytes flavus alascensis RIDGWAY, Proc. Biol. Soc. Washington, vol. 16, p. 105, Sept. 30, 1903 (St. Michael, Alaska).

Budytes flavus leucostriatus, NELSON, Report upon natural history collections made in Alaska, p. 206, 1887.

The only data on this bird in St. Lawrence Island is Nelson's statement that it is "found along the entire Bering Sea coast, wherever suitable localities are found, extending its range to St. Matthews and St. Lawrence Islands."

St. Lawrence Island birds should be carefully studied, as it may be that they may turn out to be *simillima* Hartert. Hartert²² writes that *simillima* seems to breed only in Kamchatka and wanders over Bering Island, east Siberia, and Chosen. As far as I know, no one has actually collected any specimens on St. Lawrence Island.

Family FRINGILLIDAE, Finches, Buntings, Grosbeaks

ACANTHIS LINARIA HOLBOELLI (Brehm)

HOLBÖLL'S REDPOLL

Linaria holboellii BREHM, Handbuch Vögel Deutschlands, p. 280, 1831 (middle Germany=winter migrant).

Acanthis holboelli, BROOKS, Bull. Mus. Comp. Zool., vol. 59, p. 404, 1915.

²² Die Vögel der paläarktischen Fauna, vol. 1, pp. 289-291, 1905.

Brooks collected a breeding female on St. Lawrence Island on June 27, 1913.

Collins obtained an unsexed adult on October 16 at Gambell.

CALCARIUS LAPPONICUS ALASCENSIS Ridgway

ALASKA LONGSPUR

Calcarius lapponicus alascensis RIDGWAY, Auk, vol. 15, p. 320, Oct., 1898 (St. Paul's Island, Prybilov group, Alaska).

Centrophanes lapponicus, NELSON, Birds of Bering Sea, etc., Cruise of the *Corwin*, p. 69, 1883.

Calcarius lapponicus, NELSON, Report upon natural history collections made in Alaska, p. 183, 1887.

Calcarius lapponicus alascensis, NELSON, Bird-Lore, vol. 15, p. 202, 1913.—Brooks, Bull. Mus. Comp. Zool., vol. 59, p. 409, 1915.—BAILEY, Condor, vol. 28, p. 167, 1926.

Nelson found this longspur breeding commonly on the island. The Harriman Expedition stopped at St. Lawrence Island for part of a day, July 13, 1899, and three of the members, C. H. Merriam, A. K. Fisher, and L. A. Fuertes, collected five adults and one young bird. Doctor Fisher informs me that the bird was common and was the only land bird observed.

Brooks found the birds to be numerous, as did also Bailey, who found a nest with four eggs.

PLECTROPHENAX NIVALIS NIVALIS (Linnaeus)

SNOW BUNTING

Emberiza nivalis LINNAEUS, Systema naturae, ed. 10, vol. 1, p. 176, 1758 (in *Alpibus Lapponiae*, etc.=Lapland).

Plectrophenax nivalis, NELSON, Birds of Bering Sea, etc., pp. 68, 69, 1883; Report upon natural history collections made in Alaska, p. 180, 1887.

Plectrophenax nivalis nivalis, Brooks, Bull. Mus. Comp. Zool., vol. 59, p. 407, 1915.—BAILEY, Condor, vol. 28, p. 166, 1926.

Nelson found this bird breeding on St. Lawrence Island. Brooks found it common there in June, as did also Bailey in July.

Collins obtained a fully grown young bird at Gambell. Unfortunately, the specimen lacks data.

THE BRACHIAL FLEXOR MUSCLES IN PRIMATES

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The investigator who undertakes to dissect the musculature of a considerable number of mammals will at once find a diversity of conditions in the brachial flexor muscles that may well puzzle him. Recourse to the literature on the subject may shed but little light upon his particular problems, for the reason that there is considerable confusion and ambiguity in the manner in which authors dispose of this group.

The present writers found this state of affairs so unsatisfactory that they undertook an investigation of the brachial flexors that was sufficiently extensive to give them what they believe to be a proper understanding of conditions. No attempt has been made to study the situation found in a great number of genera, but fortunately their own dissections have chanced to illustrate a number of differing brachial details, which they believe to be sufficient for the purpose stated. Primates only are herein considered, except that the interesting condition in the opossum (*Didelphis*) is also mentioned, together with isolated details of representatives of one or two additional orders. The brachial flexors of these pertinent specimens will first be described, and a discussion will then follow.

Grateful acknowledgment is made to the officials of the United States National Museum for the loan of four of the specimens dissected, as well as for the numerous skeletons we have examined. In addition, six of the specimens used and now designated by Johns Hopkins University numbers were generously contributed, after their death, to that institution by the National Zoological Park. For ease of comparison the drawings have been made of uniform size, without regard to the real dimensions of the specimens. The humeral length, as given to indicate actual size, was taken from the head of the humerus to the lateral condyle.

DESCRIPTION OF THE SPECIMENS

Pan sp.—Johns Hopkins Anat. No. 38, male, with humeral length of 222 mm.; right side.

M. biceps brachii, capita longum et breve.—The caput longum arose from the supraglenoid tuberosity of the scapula as usual and passed over the bicipital groove, which is very deep in the chimpanzee. There was also an accessory, weaker head from the capsule of the joint. These two heads fused some 60 mm. below the head of the humerus. Caput breve, of about equal mass but broader than caput longum, arose with the coracobrachialis from the coracoid process. The two biceps divisions, longum and breve, fused some 70 mm. from insertion upon the radial bicipital process. The terminal tendon was about 25 mm. in length. There was quite a well-marked lacertus fibrosus.

M. coracobrachialis, partes superficialis et media.—The anomalous superficial portion took origin in common with, and upon the medial side of, the short biceps origin from the coracoid. It continued entirely superficial to all nerves and muscles of the brachium, except the dorsoepitrochlearis, to its insertion upon the medial epicondyle. It was slender but sharply defined, the distal half being nonmuscular and weakly tendinous. The musculocutaneous nerve passed between it and the coracobrachialis medius. The latter muscle constituted at first a deeper, broader layer of the common coracoid tendon. The most proximal point at which its fibers inserted upon the humerus was 10 mm. above the most distal part of the deltoid, and 15 mm. below the latissimus tendon; so no part of it could be considered as representing a coracobrachialis profundus (brevis). Insertion thence continued for 70 mm., or to a point 60 mm. above the condyle.

M. brachialis.—The medial belly of this muscle was partly divisible from the lateral along the line shown in Plate 1. The medial had the more extensive origin from the distal half of the humerus and quite to the epicondyle, and the insertion was broad and tendinous into the fossa upon the ulna just distal to the coronoid process. The partially separable lateral portion of the brachialis had a shorter origin adjoining and partly surrounding the deltoid insertion, the muscle beginning farther proximally on the lateral than it did on the medial side of the deltoid insertion. Most of this division was situated lateral to the biceps, but distally it twisted to the rear of the latter, the fibers being pennated upon a narrow, tendinous band, which fused with the anterior border of the main insertion of the brachialis medialis.

M. epitrochleo-anconeus.—This slip does not belong with the brachial flexors, for it is innervated by the ulnar nerve, as we have

repeatedly found. Yet it is so easily mistaken either for a part of the brachialis or of the coracobrachialis, according to variations in other details, that it will be mentioned. In this chimpanzee it was quite robust, arising from the entepicondylar ridge and inserting fleshily upon the olecranon.

Pan sp.—Left side.

M. biceps brachii, capita longum et breve.—Origin of the caput longum had three separate attachments, two as on the right side and the third almost as tendinous as, and covering, the proprius origin. Also the tendinous part of the origins of both biceps divisions was markedly shorter (more fleshy) than on the right. Upon the latter side the broadest part of the biceps (at the distal third) was 36 mm.; upon the left, 60 mm. Other details were bilaterally similar.

M. coracobrachialis medius.—This had the usual origin from the deep part of the common coracoid tendon but was slightly broader than on the right and more fleshy. The medial part of the origin continued superficial to the musculocutaneous nerve, while the remainder, or more lateral part of origin, passed deep to the nerve. The latter therefore pierced the muscle, and at this point the two parts of the muscle were about of the same mass. The part located deep to the nerve was inserted narrowly (less than 1 cm.) immediately below the latissimus tendon, but the more medial portion was continued as a narrow, fibrous band distal to the other head. With the exception of this tendon there was a hiatus of some 18 mm. between the insertions of the two parts of the coracobrachialis, and the division superficial to the nerve thereafter inserted upon the humeral shaft for a distance of some 30 mm. In the vicinity of the elbow the median nerve passed superficial to all parts of the coracobrachialis.

The remainder of the flexor details were similar to those of the right side.

Hylobates lar.—Johns Hopkins Anat. No. 261, male, with humeral length of 215 mm.; right and left sides.

M. biceps brachii, capita longum et humerale.—In this gibbon the long head had a normal origin from the glenoid border of the scapula, except that the tendon was hollow, taking a stout probe for its full length, and this tendinous cylinder was naturally split along one side where the muscle fibers began. It inserted by a strong tendon upon the radius. The other head, termed humerale rather than breve for the reason that it differed markedly from the latter and that there is no absolute assurance that it was derived from the more usual breve, took origin not from the coracoid, but by tendon from the lesser tuberosity immediately adjoining the bicipital groove. Its tendon

was several centimeters long, and upon it was directly inserted the pectoralis major, without accessory attachment to the bone. The dorsomedial border of the proximal third of the fleshy portion of this biceps head was fused with the ventral border of the dorsoepitrochlearis and medial intermuscular septum, and a slender tendon, extending along the dorsomedial border of this biceps head, fused with the other slender tendon continuing distally from the dorsoepitrochlearis, attached to the epicondyle. Below the point of fusion the more dorsal fibers of the distal part of this biceps arose from the above common tendon. The two heads of the biceps fused at about the middle of the brachium, but the humeral head again separated at the point where the insertional part of the long head became tendinous, and the humeral head, passing medially upon the antibrachium, was inserted neither by a lacertus nor upon the ulna, but powerfully and fleshily into the substance of the flexor digitorum sublimis going to the fourth and fifth fingers, the fibers of the two muscles being uninterruptedly continuous. Thus the humeral biceps and the superficial digital flexor may act as one continuous, long muscle.

M. coracobrachialis medius.—No profundus (brevis) was present and the musculocutaneous nerve passed neither through the muscle nor between it and the bone. In other words, the nerve passed entirely medial and superficial to the coracobrachialis without crossing the brachium. The muscle arose broadly and almost entirely fleshily from the coracoid. The insertion was in no part upon the latissimus tendon, as has been stated by Kohlbrügge (1890), but began upon the bone of the humeral shaft immediately adjoining the termination of the latissimus tendon along its distal third, and thence for a distance of 48 mm.

M. brachialis.—This was represented almost entirely by the internal head, origin beginning 23 mm. above and medial to the deltoid termination, which continued unusually far down the arm in this animal. Insertion was as usual upon the ulna, broad, and partly fleshy.

There was no trace of an *epitrochleo-anconeus*.

Pithecus rhesus.—Carnegie Lab. Embryol., female, with humeral length of 131 mm.; left side.

M. biceps brachii, capita longum et breve.—In the macaque the attachments were found to be as usual, origin being from the glenoid border and the coracoid, respectively, and insertion tendinously upon the bicipital process of the radius. The bicipital groove was shallow, and both bellies were relatively much more slender than in the chimpanzee. Both heads were of equal size and separable to within a

short distance of insertion. The short head was more completely integral with the coracobrachialis origin than in *Pan* or man, many of its deeper fibers arising directly from the coracobrachialis tendon and the two not separating completely until after passing the latissimus tendon. There was no lacertus fibrosus.

M. coracobrachialis, partes profunda et media.—The pars profunda was entirely distinct from the media, arising fleshily, mostly from the posterior (medial) border of the common coracoid tendon but also partly deep to the tendon and from the coracoid proper. It curved around deep to the tendon to insert upon the surgical neck of the humerus, mostly proximal to the latissimus insertion, although a few fibers overlapped the latter for a couple of millimeters, both superficial and deep to its proximal border. The pars media was very slender and small, with the musculocutaneous nerve passing between all of it and the bone. Its fibers arose from an aponeurosis upon its deep surface, which in turn was a continuation of the coracoid tendon, and it inserted upon an area but 10 mm. long beginning 23 mm. below the latissimus tendon.

M. brachialis.—This muscle was not longitudinally divisible and was relatively much less robust than in *Pan*. Origin began from an oblique line that extended from above the termination of the deltoid on the lateral aspect of the arm to a point well below the deltoid on the medial aspect, and thence straight to the fleshy insertion, which was partly upon the joint capsule but chiefly upon the ulna.

There was no *epitrochleo-anconeus*.

Cebus variegatus.—Johns Hopkins Anat. No. 1, male, with a humeral length of 78 mm.; right side.

M. biceps brachii, capita longum et breve.—The two heads had their usual origins, and the tendon of the longum was completely within the shoulder capsule, although the bicipital groove was not particularly deep. Muscle fibers developed at about the level of the latissimus tendon. Fusion of the two heads took place at the distal third of the brachium, and the common, tendinous insertion was upon the radius. There was no trace of a lacertus fibrosus.

M. coracobrachialis, partes profunda et media.—The deep or short part was large and well developed, with fleshy origin from the coracoid deep to the common tendon, and insertion upon the surgical neck of the humerus behind the latissimus tendon. In a second specimen of *Cebus* (*C. apella*, Johns Hopkins Anat. No. 2) this part of the coracobrachialis was absent.

The coracobrachialis medius split from the common coracoid tendon just below the latissimus and inserted upon the humerus, beginning about 9 mm. below the latissimus and continuing for about

8 mm. thereafter, but there was intimate connection with the intermuscular septum and the medial head of the triceps. It ended far above the epicondylar ridge, and the musculocutaneous nerve crossed the brachium deep to all of it.

M. brachialis.—This was in no degree separable into two parts and was of the usual form, its origin embracing the deltoid. Medially it arose from the humerus between a point a few millimeters above the deltoid termination and 8 mm. above the entepicondylar foramen. Laterally it extended some 5 mm. above the deltoid insertion and distally as far as the lateral condyle. The insertion upon the ulna was by a strong tendon.

M. epitrochleo-aneurus.—This was possibly, though not certainly, represented by a few fibers, which bridged the ulnar nerve. In the second specimen it was absent.

Galago sp.—U.S.N.M. No. 251756, male, with humeral length of 33 mm.; right side.

M. biceps brachii, capita longum et breve.—The long head was as usual. Over the proximal half of the brachium the short head of the biceps and coracobrachialis medius, with common origin from the coracoid, constituted a single, bipennated muscle, the two thence continuing separately. Insertion of the short head was by means of (1) a lacertus fibrosus superficially over the medial antibrachium; (2) an aponeurosis passing medially between the pronator teres and flexor carpi radialis, this undoubtedly operating upon the ulna by means of the intermuscular septum; and (3) a slender, tendinous band passing from the lateral belly of the short biceps to the tendon of the long head inserting upon the radius.

M. coracobrachialis, partes profunda et media.—The short, deep head passed from the coracoid deep to the teres major insertion, the latter being entirely fleshy and broader, both proximally and distally, than the latissimus insertion. The musculocutaneous nerve crossed the humerus entirely deep to the media division, not immediately adjoining its insertion, but quite far above it. Insertion was upon an area of the humerus from the teres major tendon to the level of the entepicondylar foramen.

M. brachialis.—This muscle was not longitudinally separable, at least with any clarity, as was the case with *Tarsius*. Otherwise it was similar in both.

M. epitrochleo-aneurus.—Origin was from the entepicondylar ridge below the level of the foramen. It was smaller than in *Tarsius*.

Nycticebus sp.—U.S.N.M. No. 142235, male, with humeral length of 54 mm.; right side.

M. biceps brachii longum.—The single head of this biceps was quite robust. It arose by a sharply defined tendon from the glenoid border at the coracoid base, passed through a well-defined bicipital groove, and inserted upon the radius only. There was no *lacertus fibrosus*.

M. coracobrachialis, partes media et profunda.—Common origin was shortly tendinous from a coracoid process that was unusually long. Pars profunda was short and inserted upon the surgical neck on a level with the *teres major* insertion, which was very broad and which extended above the *latissimus* tendon at this point. Pars media was entirely superficial to the musculocutaneous nerve and was exceedingly long, inserting from the *teres major* practically to the epicondyle. Just above the latter point the muscle divided into two slips between which passed the median nerve, which then continued to the entepicondylar foramen. The manner in which this muscle passed upon either side of the median nerve was encountered in no other simian or prosimian dissected.

M. brachialis, partes lateralis et medialis.—This muscle was almost completely divisible. No part of the medial division originated above the deltoid insertion and it was much smaller than the lateral division, which took origin not only from the humerus but also from the aponeurotic investment of the deltoid along the oblique line of its insertion. Insertion of the brachialis was upon the ulna, as usual.

No trace of an *epitrochleo-anconeus* was encountered.

Tarsius (philippinensis?).—U.S.N.M. No. 218238, male, with humeral length of 29 mm.; right side.

M. biceps brachii, capita longum et breve.—These heads had the usual origins from the glenoid border and the coracoid, respectively, and both inserted upon the bicipital process of the radius; but they were entirely separable throughout their length. The same condition was encountered in *Tarsius saltator* (Johns Hopkins Anat. No. 169, female). Distally the long head was situated fairly anterior to the short one (there was no twisting), and the insertion of the latter was slenderly tendinous, but the former was chiefly fleshy and was the broader throughout its length. There was no sign of a *lacertus fibrosus*.

M. coracobrachialis, partes profunda et media.—The pars profunda may be said to have had no connection with the common coracoid tendon but arose independently and fleshily from the coracoid, thence extending directly to the surgical neck of the humerus and inserting as far as the distal border of the *teres major* tendon (in this animal quite separate from the *latissimus* tendon) and entirely deep to the tendon. The pars media split cleanly from the biceps breve some 6 mm. from the origin. The musculocutaneous

nerve passed entirely deep to the muscle, and insertion was upon the shaft from a point immediately beyond the latissimus tendon to a situation upon the epicondylar ridge just short of the entepicondylar foramen, and hence not to the epicondyle proper.

M. brachialis, partes lateralis et medialis.—The brachialis was primitively and entirely separable throughout its length. The more medial head originated fleshily from the humeral shaft just beyond the pectoralis insertion, while origin of the lateral head was chiefly tendinous from the extreme proximal part of the surgical neck. Insertion was by two tendons upon the ulna.

In *Tarsius saltator* the brachialis could not be clearly separated into two parts, there being only slight indications of a longitudinal splitting. The insertion was by a single tendon upon the ulna.

M. epitrochleo-anconeus.—This small slip, innervated by the ulnar nerve, arose from the epicondylar ridge below the level of the entepicondylar foramen, and its conformation was such that it would be extremely easy to mistake it for a condylar extension of the coracobrachialis medius.

Didelphis virginiana.—Johns Hopkins Anat. No. 117, male, with humeral length of 57 mm.; left side. An opossum was dissected in order to present the arrangement of the brachial flexors in a primitive marsupial.

M. biceps brachii, capita longum et breve.—The long head arose from the supraglenoid border of the scapula by a tendon that passed through the bicipital groove and that seemed to be at least partially within the capsule of the shoulder joint. The short head took origin, by fibers partly muscular and partly tendinous, from the inner side of the tip of the coracoid process. This head crossed in front of the caput longum at the elbow and inserted upon the radius by a strong tendon. The long head, passing inward, united with the brachialis to insert by a tendon upon the ulna. It is thus apparent that the two heads were separate for their entire length. There was no *lacertus fibrosus*.

M. coracobrachialis profundus.—Since the medius division was entirely absent, the coracobrachialis was represented only by the short or profundus element. This was a large and well-developed muscle. Its origin was by a tendon from the inner and under aspects of the coracoid process. Broadening and developing muscle fibers, it inserted upon the medial side of the neck of the humerus above and behind the tendons of the *teres major* and *latissimus dorsi*.

M. brachialis.—This arose strongly from the outer side of the humerus as high as the level of the *latissimus* insertion and from

the anterior surface of the bone as high as the prominence marking the end of the deltoid ridge, continuing along the outer side of same for a few millimeters. These two origins were partially separable almost as far distally as the tendon. The insertion was in common with the long biceps head by a common tendon on the ulna.

There was no *epitrochleo-anconeus*, but just dorsal to the region where this muscle might be expected to occur there was a *M. anconeus internus*, which was served by the radial nerve and passed from the posterior portion of the epicondyle to the olecranon. The position of this slip, which is a triceps element, served in this case to distinguish it from a true *epitrochleo-anconeus*, originating from the anterior epicondyle; but in some mammals (rodents) this topographical difference seems not to exist, and identification is determinable on innervation alone.

In addition to the specimens described above, we have examined the brachial flexors of certain other primates: The Old-World monkeys *Pygathrix entellus* (U.S.N.M. No. 25215), *Papio hamadryas* (Johns Hopkins Anat. No. 149), and *Lasiopyga pygerythra* (Johns Hopkins Anat. No. 148); the New-World monkeys *Ateles geoffroyi* (Johns Hopkins Anat. No. 190), *Alouatta seniculus* (Johns Hopkins Anat. No. 13), *Saimiri sciureus* (Johns Hopkins Anat. No. 8), *Aotus zonalis* (2 specimens, Johns Hopkins Anat. Nos. 237 and 244), and *Oedipomidas geoffroyi* (Johns Hopkins Anat. No. 234); and the lemur *Perodicticus potto* (Johns Hopkins Anat. No. 283). These do not depart in any significant respect from the other specimens of Old and New World monkeys and lemurs described, and detailed accounts of them are therefore omitted. Certain arrangements in the musculature and nerves of these primates are, however, referred to in the succeeding discussion.

DISCUSSION

The intrinsic musculature of the brachium comprises only the so-called extensors of dorsal innervation—the triceps complex—and the so-called flexors of ventral innervation served by the musculocutaneous nerve. It is only with the latter group that we are at present concerned, although for convenience we have also mentioned the epitrochleo-anconeus. The latter is served by the ulnar nerve and is clearly a derivative of the antibrachial flexor carpi ulnaris element, although some authors have erroneously classified it with the triceps group. Its fibers have secondarily migrated above the elbow or else represent a primitive humeral origin of the ulnar flexor. It is not clear which of these interpretations should be regarded as the more probable.

The brachial flexor group as it now occurs in mammals comprises the so-called biceps brachii, coracobrachialis, and brachialis. As they are all served by the musculocutaneous nerve, they should be regarded as originally a single genetic complex, which later differentiated into the existing elements, and it is more difficult to assign to each its precise phylogenetic position than would be the case if the group were innervated by two or more nerve components.

It seems likely that the ideally primitive differentiation of this complex into separate elements was upon the plan of a single, long, or two-joint flexor from the shoulder to the antibrachium (coraco-antibrachialis), and two short or one joint flexors, a proximal one from the shoulder to the humerus (coracobrachialis) and a distal one from the humerus to the antibrachium (brachio-antibrachialis). As there is still controversy over the question of whether the present mammalian coracoid actually represents the primitive coracoid or the procoracoid, it seems futile to speculate seriously as to the exact point upon the primitive shoulder girdle from which arose the two ideally primitive flexors of the brachium that were attached thereto.

The long flexor and the more proximal of the short flexors above referred to were the precursors of the biceps and coracobrachialis. That the short biceps, from the coracoid, represents a more primitive arrangement than the long head, with its origin from the bicipital tubercle upon the glenoid border of the scapula, is indicated by the fact that the long head, as such, is apparently found only in those vertebrates higher than the reptiles.

Whatever was precisely the original arrangement of these two flexors, there accordingly seems to have been a later stage during which they were confined to an exclusive origin, both of them from the coracoid process of the scapula. At that time, therefore, they probably had much in common, and it is likely that the part representing the biceps inserted upon both radius and ulna, while that representing the coracobrachialis inserted upon the humeral shaft. Because of their community of origin, however, it is possible that some interchange of fibers took place as specialization occurred. In other words, some of the true biceps fibers, partially fused with the coracobrachialis, may secondarily have developed attachment to the humerus, thereby increasing the area of coracobrachialis insertion, while some of the true coracobrachialis fibers could conceivably have separated and taken on an elongated form that would later give them considerable resemblance to a biceps division. And their innervation would not help us to segregate them according to their actual derivation.

At least the assumption may be granted, however, that the brachial flexor now passing from the coracoid to the forearm (*caput breve*)

represents a portion of the original biceps element, from which was later derived that element (*caput longum*) almost invariably encountered in mammals, from the glenoid border to the forearm. Similarly it must be conceded, for convenience at least, that those elements passing from the coracoid to any part of the humerus represent the coracobrachialis.

Representing the third primitive flexor of the brachium is the brachialis, the more distal of the two short flexors. Although the mass may be either longitudinally divisible or single, and the origin may migrate up or down the humerus, it is always composed of fibers arising from the humeral shaft and inserting upon the ulna. In its idealistically primitive form its plan probably consisted of an origin from the entire humeral shaft, and insertion upon both anti-brachial bones.

M. biceps brachii.—As the long head of the biceps is absent in all vertebrates below the reptiles, we may presume that it was a later development from the short or coracoid head. This being the case, it is somewhat unexpected to find that in mammals the long head is by far the more conservative, apparently being always present. It arises from the bicipital tuberosity, or *tuberositas supraglenoidalis*, of the scapula at the lateral base of the coracoid process. It passes over the head of the humerus, either partially or completely deep to the shoulder capsule, and through the bicipital groove, or *sulcus intertubercularis*, between the greater and lesser tuberosities of the humerus. This groove is shallow or deep. The muscle ends invariably in a tendon, which inserts upon the bicipital or radial tuberosity of the radius, or the adjoining part of the ulna, or both. The insertion has fair but not complete group constancy. In marsupials the short head always goes to radius, the long head to ulna (Leche, 1900). Among primates, on the other hand, it is the rule for both heads to have a common tendon of insertion upon the radius alone. In many rodents there is but a single head, and where this is the case the tendency seems to be for the insertion to be ulnar; but in the seal and sea lion the single head has the radial attachment. At any rate the attachment of this head is always firmly upon the bone.

Among primates, apparently only the lorises (*Nycticebus*, *Loris*, and *Stenops*) normally have but a single biceps head, of the long variety (Owen, 1868; Murie and Mivart, 1872; Zuckerkandl, 1898; Howell and Straus), yet even in these animals a short or coracoid head may occasionally be present (see Murie and Mivart, 1872).

Where a second head is present this usually arises from the coracoid process and constitutes the regular *caput breve*. In reality there may be considered to be a common tendinous origin of this head and the coracobrachialis, from the superficial aspect of which

the tendon of the short biceps may usually separate quite high up at times (as in *Pithecus*), with some of the biceps fibers arising from the coracobrachialis tendon below the point of separation. More rarely the fission does not occur until quite at the middle of the brachium (as in *Galago*).

Usually there is fusion of the long and short heads of the biceps, most frequently at about the middle of the brachium or a bit below (as in *Pan*, *Papio*, *Pygathrix*, *Cebus*, *Aotus*, and *Perodicticus*), or occasionally this does not take place until within a short distance of the insertion (as in *Pithecus*, *Lasiopyga*, and *Ateles*), and rarely the two heads are entirely separate throughout their length (as in *Tarsius* and *Didelphis*). In man the two heads of the biceps usually fuse well above the tendon, but at least in some of those cases in which the two are separable as far as the tendon it is easily demonstrable that both heads are concerned with the formation of the radial bicipital tendon.

Whereas insertion of the longer biceps is invariably on bone, that of the shorter head is more variable, going in some cases to the radius, to the ulna, or having a variety of fascial attachments. The best known of the latter is represented by the lacertus fibrosus or semilunar fascia as of man. This takes the form of a tough fascial connection between chiefly the short biceps and the medial anti-brachium, concerned with certain of the antibrachial flexors. This we have found to be indubitably present in such primates as *Pan*, *Ateles*, *Aotus* (2 specimens), and *Galago*; absent in *Hylobates*, *Pygathrix*, *Papio*, *Pithecus*, *Lasiopyga*, *Cebus* (2 specimens), *Saimiri*, *Nycticebus*, *Perodicticus*, and *Tarsius* (2 specimens). From the condition typical of man there are found several fascial variations. In *Galago*, for instance, we found that there was not only a superficial lacertus as well as tendinous attachment of the short head to the radial insertion of the longum but in addition a fascial band that was intermediate in position between the other two and that passed deep between the pronator teres and flexor carpi radialis, probably operating directly upon the ulna by means of the intermuscular septum. On the other hand, in *Hylobates lar* the shorter biceps head, analogous and possibly homologous to the usual caput breve, diverged from the common biceps mass to fuse completely with the substance of the flexor digitorum sublimis, the fibers of the two being perfectly continuous and acting in some respects as a single muscle extending from shoulder to digits. It is easy to see how such a situation could have developed from a lacertus, or how insertion by means of the latter could shift to intermuscular septa and so reach the bone.

In a chimpanzee dissected by Grönroos (1903), the bicipital slip to the forearm fascia was fleshy, thereby contributing a "lacertus carnosus." Duvernoy (cited by Sommer) and Sommer (1907) found quite similar arrangements in their gorillas, as did Duckworth (1915) in *Lemur*. This condition, however, appears to be quite different from the arrangement in gibbons. In general, the lacertus fibrosus is much more frequently absent in prosimians, monkeys, and anthropoids than it is in man.

In man there may be accessory heads to the biceps, usually concerned with the caput longum, to the number of three. Very rarely are there this many, but it is not very unusual to find at least one. Such an extra head does not mean an extra muscle, of course, but only that one head of the biceps has more than one attachment at origin. These extra heads may arise in various ways; for example, very frequently from the capsule of the shoulder joint or from the shaft of the humerus itself.

We were fortunate in finding a condition of the former sort in the chimpanzee that we dissected. Upon the right side the origin of the caput longum had two attachments, one proper and the other from the capsule of the joint, both fusing some 60 mm. below the humeral head. Upon the left side there were two extra attachments to the capsule.

In one specimen of *Aotus* (Johns Hopkins Anat. No. 237) we found in the left arm what was apparently a humeral biceps head. This arose from the medial edge of the bicipital sulcus, immediately adjacent and lateral to the insertion of the coracobrachialis medius, beginning a few millimeters above the distal border of the latissimus dorsi tendon and continuing for a short distance below. This muscle was smaller than either of the two usual biceps heads, both of which had their customary attachments. The exact distal connections of this extra muscle could not be ascertained because of the fragile condition of the tissues of this specimen. Accessory biceps heads with origin very similar to that occurring in this *Aotus* appear to be not infrequent in man, as observed by us and others in the dissecting room. Thus among 37 arms (23 negro, 14 white), representing 20 bodies (12 negro, 8 white), in which this detail was particularly sought, we found an accessory humeral head occurring six times (5 negro, 1 white), and an accessory capsular head once (negro). Testut (1884) has reported the occurrence of a humeral biceps head in 31 out of a total of 299 subjects, all of which were presumably white. Our own figures in this connection suggest that accessory humeral heads may occur more frequently in negroes than in whites. Naturally, however, our data are as yet too meager for

any emphasis to be placed upon this point. These humeral heads, although fleshy, were usually rather weakly developed. Origin was always above the middle of the humerus lateral to and coextensive with the insertion of the coracobrachialis medius; while insertion was into the posteromedial aspect of the common biceps mass just above the elbow.

The occurrence of a humeral biceps head in *Aotus*, as mentioned above, should not be regarded as normal for the genus, however, for this extra muscular slip was not present in the other arm, nor in the upper extremities of an additional specimen (Johns Hopkins Anat. No. 244) that we investigated. Nor does the presence of accessory biceps heads in our chimpanzee represent the normal condition in this animal. In fact, accessory heads for the biceps would seem to occur quite infrequently in primates other than man and gibbons. Testut (1884) described an extra or capsular head in a *Cercopithecus* (= *Lasiopyga*). Chudzinski (cited by Kohlbrügge, 1897) found a humeral head in two out of five orang-utans that he studied. This extremely low frequency of extra heads in monkeys is worthy of note, especially in view of Grönroos's (1903) speculations concerning the evolution of the human biceps. This theory will be considered subsequently.

In some respects these accessory biceps heads may be largely fortuitous, although possibly atavistic,¹ but it is at least shown that this detail readily responds to variational stimuli. If it be in response to some need for a humeral attachment, then a continuation and strengthening of the stimulus might well result, finally, in the migration of a part, or indeed the whole, of the primitive coracoid head to the humerus. This, we are inclined to think, may be just what has happened in the case of *Hylobates*. In the specimen of the latter dissected by us the long head had, immediately adjoining, another head, which in all respects was comparable to a *caput breve* except for the fact that origin was strongly from the lesser tuberosity of the humerus immediately adjacent to the bicipital groove and not at all from the coracoid. This would appear to be the usual arrangement in the *Hylobatidae*. Though this assumed migration of the *caput breve* was complete in our gibbon, it appears to have been incomplete in other instances. For example, the rodent *Viscacha* was found by Parsons (1894) to have, in addition to a normal longum and breve, just such a humeral head, but from the greater instead of the lesser tuberosity. Kohlbrügge (1890) found similar conditions in *Hylobates leuciscus*, but in *H. syndactylus* the cora-

¹ The accessory biceps head in our chimpanzee, arising superficially from the capsule, and the comparable conditions occurring in man might be interpreted as indicating transitional stages in the migration of the long head from a coracoid to a supraglenoid origin.

coid head was vestigial, and in *H. agilis* entirely absent. The assumption of complete or partial migration of the coracoid head in *Hylobates* is strengthened by the fact that in the occasional instances in which both coracoid and humeral heads occur in the same specimen of gibbon, the former, according to data collected by Grönroos (1903), is usually weakly developed. But Grönroos did not consider the humeral head (which he termed caput tuberculo-septale) of the Hylobatidae as homologous with the usual coracoid head, but rather that the two are distinct structures, of which as a rule only one develops; for example, in man the coracoid and in the gibbon the "tuberculo-septal" head. This assumption is hardly justified by comparative anatomical facts, despite its ingenious application by Grönroos in attempting to explain the accessory biceps heads in man.

Really the most interesting and peculiar thing about the condition in *Hylobates* is that the pectoralis major is inserted directly upon the tendon of origin of this caput humerale of the biceps.² This is very significant. By this means flexion of the pectoralis not only acts through the biceps, but continuously as far as the wrist by virtue of biceps-flexor digitorum sublimis fusion. If the pectoral thus acted upon a biceps with long tendon from the scapula the effect might be much less efficient, because a longer tendon would give more slack than one firmly anchored to the lesser tuberosity. One should note that this action of the pectoral through the biceps is more effective when the gibbon arm is elevated sideways, thus putting the pectoral under tension, than when elevation is accomplished in the sagittal plane.

This does not exhaust the interesting details of the gibbon biceps, however. The dorsomedial border of the proximal third of the fleshy portion of the humeral head was fused with the ventral border of the dorsoepitrochlearis, and a slender tendon, running along the dorsomedial border of this biceps head, fused with the slender tendon continuing to the epicondyle from the dorsoepitrochlearis. It thus appears that when the pectoralis is acting upon the antibrachium through the humeral biceps, the fusion of the latter with the dorsoepitrochlearis prevents the biceps from springing forward unduly and thus weakening the action. Grönroos (1903) has also discussed the action of such a muscle complex; that is, from latissimus dorsi through latissimo-condyloideus (sive dorsoepitrochlearis) through caput tuberculo-septale (sive caput humerale) to

² Grönroos apparently doubted that the humeral head ever arises in *Hylobates* from the pectoralis major tendon, as some authors have stated, and in his specimens he interpreted the situation as fusion of the two structures. In our specimen, at least, there was no shadow of doubt that the pectoralis major was actually inserted upon, or into, the tendon of the humeral head.

flexor digitorum sublimis. He indicated that such an arrangement is important to the gibbons in making their tremendous leaps from branch to branch.

This curious and apparently unique specialization of the brachial flexors in the gibbon appears to us more as a secondary adaptation of purely functional significance, and we are of the opinion that little or no phylogenetic import should be attached to it. In this view we disagree completely with Grönroos, who concluded that the three great apes, the gibbons, and man all passed through a stage in which the biceps brachii possessed three heads—supraglenoid, coracoid, and tuberculoseptal. His ingenious theory, based chiefly upon the positions of supernumerary humeral biceps heads (which he regarded as remnants of the caput tuberculoseptale) appears to us as unconvincing, for consideration of the biceps morphology in the various groups of primates does not lend support to his views.

Mention should also be made of other theories concerning the phylogeny of the biceps. Humphry (1872) homologized the two heads of the biceps of man with the entire coracoradialis (caput longum) and the outer portion of the coracobrachialis longus (caput breve) of the urodele amphibian *Cryptobranchius japonicus*. Welcker (1878) found that in some mammals (as the tapir) the tendon of the caput longum lay outside of the capsule. In other forms the tendon exhibited various degrees of encapsulation. He likewise found a gradual ontogenetic migration within the capsule occurring in some forms (beaver, *Cebus*, man), and therefore came to the conclusion that the tendon of the caput longum has secondarily migrated within the capsule of the shoulder joint. This supports other comparative evidence that indicates that the supraglenoid origin of the long head is a relatively late phylogenetic acquisition. Fürbringer (1876) was inclined to the view that the caput longum is homologous with the entire coraco-antibrachialis of reptiles, the caput breve being derived from the coracobrachialis. Eisler (1895) secondarily derived the caput breve from both the coracoradialis and coracobrachialis longus of urodele amphibians. He did not definitely commit himself in respect to the caput longum, but listed three possible explanations: (1) It is a part of the coracoradialis proprius, which has gained attachment to the scapula; or (2) it is a part of the caput breve, which has become attached to the ligamentum humero-radiale (sive capsuloradiale), which is itself the degenerated tendon of the original coracoradialis proprius; or (3) it represents a combination of the two preceding processes. Lubosch (1899) regarded the caput longum as a derivative of the accessory or humeral head of the coraco-antibrachialis of reptiles.

Despite the differences in these theories there seems to be general agreement that the supraglenoid origin of the long head is a secondary occurrence. As stated earlier in this paper, we are personally inclined to favor the theory that derives both biceps heads from a primitive coraco-antibrachial flexor, the outer portion of which has migrated to the supraglenoid border, while the inner has retained its coracoid origin, possibly strengthened by additional fibers from the primitive coracobrachialis.

Attention must be given to the possible significance of the *lacertus fibrosus*. Grönroos regarded this as a vestigial structure, the remains of the fleshy ulnar extension of the supposedly primitive *caput tuberculoseptale* of the gibbons. The frequent absence of the *lacertus fibrosus* in the three great apes, together with the fact that supernumerary biceps heads apparently occur less frequently in these animals than in man, led him to the conclusion that the biceps muscle in all three anthropoids is more specialized than in man. It seems that he was probably correct in asserting that retention of the *lacertus* is more primitive than is its loss. There is, however, no reason for regarding the condition in the gibbons as other than an extreme specialization. The *lacertus* possibly represents a portion of the original ulnar insertion of the primitive coraco-antibrachial flexor. At least the conditions in our *Galago* are extremely suggestive of such an interpretation.

M. coracobrachialis.—In man, where ordinarily there occurs but one well-defined coracobrachialis element, inserting upon the middle of the humeral shaft, there is no difficulty met with, or at least any question that may occur does not greatly worry the human anatomist. But in many other mammals the conditions that occur in this muscle have been extremely puzzling, which is largely attributable to the loose manner in which the term "longus" has been used for an occasionally present distal extension.

Comparative anatomists usually follow Wood (1867) when differentiating parts of the coracobrachialis. This authority recognized a *pars brevis*, or *coracocapsularis*, arising from the coracoid and inserting upon the neck of the humerus above the tendon of the *latissimus dorsi*, a *pars media* or *propria*, inserting below the *latissimus*, and a *pars longa*. In regard to the last his statements were at times ambiguous, and he seems to have used the term indiscriminately to designate both the distal part of the *pars media*, when this extended down the shaft to a marked extent, and another structure, totally distinct in conformation. The latter has probably been found by few anatomists, and by the same token it is probably poorly understood, so that subsequent writers have readily fallen in with the same ambiguity of Wood's paper.

As it is likely that all parts of the present coracobrachialis are derivatives of one original component, the terms by which we designate the several divisions that may occur are not of paramount importance, but at least they should be uniformly applied. For the reason that there has been so much confusion in the treatment of the so-called long division, we prefer to abandon this term in favor of "superficialis."

Occasionally in man there occurs a coracobrachialis brevis, or "profundus," as we designate it (also termed coracocapsularis, coracobrachialis superior, coracohumeralis superior, and rotator humeri). Eisler (1895) saw it at least twenty times in nine years, and Wood reported that he had met with it four times. Among 39 arms (24 negro, 15 white), representing 20 individuals (12 negro, 8 white), examined carefully for this detail, we found a coracobrachialis profundus in three instances (2 negro, 1 white). In each case the nerve supply had unfortunately been destroyed before we saw the muscle. These three examples exhibited certain differences in their morphology, and it seems worth while to describe them in some detail.

In the left arm of an extremely muscular male negro a coracobrachialis profundus arose from near the tip of the coracoid process as a broad and fleshy slip, which inserted above and behind the latissimus dorsi tendon. The coracobrachialis proprius (or medius) exhibited its customary relations, and it was pierced as usual by the musculocutaneous nerve. Upon the right arm the profundus element was entirely absent.

The second example of this muscle was found in the right arm of a well-developed male negro. It arose from near the anterior end of the coracoid process and continued fleshily to insert above and behind the latissimus dorsi tendon; and likewise by a short, tendinous extension upon a second, long tendon, which arose from the surgical neck of the humerus and which continued distally to pass uninterruptedly into the medial intermuscular septum. The coracobrachialis proprius was quite normal and was pierced by the musculocutaneous nerve. There was no trace of a coracobrachialis profundus upon the left arm.

The third occurrence of this slip was upon the right arm of a male white. It was unusual in that it arose not from the coracoid tip, but broadly and fleshily from the medial border of this process for a considerable distance. It inserted above the latissimus dorsi tendon. The coracobrachialis proprius was normal and was pierced by the musculocutaneous nerve. The left arm exhibited no trace of a profundus element.

In primates the coracobrachialis profundus is a short and relatively broad, entirely fleshy slip arising either from the deep part

of the common coracoid tendon, or else from the coracoid proper posterior to the tendon. Insertion is invariably upon the neck of the humerus either entirely proximal to, and back of, the tendon of the latissimus dorsi, as we found, for example, in the potto (*Perodicticus*), or else overlapping the tendon by only a couple of millimeters, as we found in the macaque (*Pithecus*). Occasionally it is extremely slender, as in the spider monkey (*Ateles*) that we dissected.

According to Parsons (1898) this slip is present in some genera and absent in others of the marsupials, edentates, cetaceans, ungulates, rodents, carnivores, insectivores, and primates, and is always absent in bats. Parsons and other authors give long lists of the genera concerned, but there is no need to repeat these lists here. Among the primates, however, Parsons stated that it is present in more than 30 per cent of chimpanzees but is less frequent in gorillas and oranges, while it is always present in lemurs. Keith (cited by Parsons, 1898) reported it as rarely absent in cynomorphous monkeys.

A survey of the available literature reveals the fact that this muscle is present regularly in lemurs and *Tarsius*, is usually present in both catarrhine and platyrrhine monkeys, and occurs only very occasionally in anthropoid apes other than the chimpanzee.³

Apparently, then, this structure is present in some genera of all primate families but is absent in others, and so it is not a very important phylogenetic index; but whether its significance is purely functional it is difficult to say. Parsons (1898) suggested that the suppression of this muscle might be attributable to, or correlated with, the setting back of the shoulders. In general, however, it is usually present in the more primitive primates and tends toward complete disappearance in the so-called "higher" forms. The important point is that when it occurs at least most of its fibers are located entirely proximal to, and usually deep to (behind), the latissimus tendon. Therefore it is usually separated from the pars media by the latter tendon.

The coracobrachialis medius, or "proprius," always originates from the coracoid, and it can always be identified by this fact, together with the circumstance that it inserts upon the shaft of the humerus, although occasionally the relationship of its terminal fibers with those of the medial triceps is extremely close (as in *Cebus* and *Perodicticus*). Otherwise it is quite variable. Origin is usually

³ According to the data that we have collected from the literature and to which we have added the results of our own dissections, the coracobrachialis profundus (brevis) has been found in 1 out of 10 gorillas (10 per cent), 4 out of 13 chimpanzees (31 per cent), and 1 out of 10 orang-utans (10 per cent). It was not found among 8 gibbons. We ourselves have met this structure, but in various degrees of development, in *Pithecus*, *Papio*, *Lastopyga*, *Cebus* (first specimen), *Saimiri*, *Ateles*, *Aotus* (two specimens), *Oedipomidas*, *Galago*, *Nycticebus*, *Perodicticus*, and *Tarsius* (two specimens), but not in *Pan*, *Hyllobates*, *Pygathrix*, and *Alouatta*, nor in our second specimen of *Cebus*.

tendinous, the common tendon of this and the short head of the biceps being separable into two tendons a short distance from the coracoid. Occasionally fission takes place somewhat farther down the arm (as in *Saimiri*), or the tendon does not divide at all, the fleshy part of both biceps and coracobrachialis originating from the common tendon in a bipennated manner (as in *Perodicticus* and *Galago*), the two being separable only over the distal half of the brachium (as in *Galago*). Or, again, in many rodents that have this muscle in depauperate form the fibers of the coracobrachialis originate directly from the single tendon of the caput breve of the biceps. At times in man we have found the more proximal fibers of the coracobrachialis medius inserting not upon the bone, but directly upon a flat tendon (internal brachial ligament of Struthers) that arises from the upper part of the humeral shaft and eventually disappears at the point where the medius begins its osseous insertion. There was a suggestion of such an arrangement in our specimen of *Lasiopyga*. Testut (1884) has suggested that this long tendinous band may be a possible vestige of the coracobrachialis longus (of Wood). It appears to us, however, as extremely unlikely that this could represent the coracobrachialis longus (superficialis) as recognized by us. The band is applied to the deep surface of the coracobrachialis proprius, whereas the pars longa, when present, lies superficial to all the muscles of the brachium except the dorsoepitrochlearis. This feature of the pars longa will be discussed subsequently.

Another feature that is extremely variable is the position of the musculocutaneous nerve in relation to the muscle. This nerve may cross the brachium above and beneath the whole muscle, or pierce it, or pass entirely below it in a manner that appears indiscriminate, not only in closely related species but also in individuals of the same species. In illustration of such variation we may cite the conditions in 32 adult white and negro cadavers that we have examined in the dissecting rooms of the Johns Hopkins University Department of Anatomy. In all but five cases, both sides were dissected. Out of 59 arms, the musculocutaneous nerve pierced the coracobrachialis in 55 instances and passed below (superficial to) the muscle in 4 (on the left side in three cadavers and on the right in the other). In those in which piercing occurs there may be as little as approximately one-sixth of the muscle deep to or above the nerve, or practically all of it, but the average is about one-half of the entire muscle located above the nerve. This probably represents with a fair degree of accuracy the condition in man (subject to an unknown degree of racial variation). Apparently it is only very rarely that the nerve passes deep to the entire muscle mass in man, but in mammals below the anthropoids this is the usual condition. In fact Parsons, than

whom no one has had more extensive experience with the musculature of the lower mammals, has stated that he has never found the nerve piercing the muscle in anything but primates.

Judged from our own dissections and from a consideration of the data given by Kohlbrügge (1897) and Bolk (1902), this feature of piercing or nonpiercing is extremely variable in monkeys and lemurs. It seems to vary not only within a single genus but perhaps even within a species. We ourselves have found the musculocutaneous nerve piercing the coracobrachialis medius only in the left arm of our chimpanzee, in *Pygathrix*, *Lasiopyga*, and *Perodicticus*. In the right arm of the chimpanzee, as in both extremities of our *Hylobates*, the nerve passed entirely superficial to the muscle. No piercing of the muscle was found in any of our other specimens of monkeys or prosimians, in which the nerve passed entirely deep to (above) all the fibers of the coracobrachialis medius, between this muscle and the bone. This arrangement obtained regardless of the absence or presence of the coracobrachialis profundus. Apparently the nerve usually pierces the coracobrachialis medius in the great apes, though possibly with less frequency than in man, at least in the chimpanzee.

Many authors, however, have evidently considered that when the nerve pierces the muscle in primates the portion superficial to the nerve and the more distally situated is a pars longa. This treatment we regard as unfortunate. The feature of piercing or nonpiercing and the proportions of the muscle parts involved are too variable to carry much phylogenetic or taxonomic weight, although for convenience it is legitimate to term the part of the coracobrachialis medius distal to the nerve by some such appellation as the distal portion, and the deeper division the proximal one. The latter we regard as never homologous to the coracobrachialis profundus or brevis, in spite of the fact that where the latter occurs the musculocutaneous nerve usually, if not invariably, passes entirely deep to the pars media, for the part of the latter above the nerve, where piercing occurs, is almost always well segregated from the area of insertion of pars profunda. That this may not invariably be the case is indicated by the mention by Parsons (1898) that continuity has been observed between the two in *Gorilla*. Also, pars media may begin to insert higher than the distal border of the latissimus tendon, as in the gibbon; not, we found, upon the tendon itself, as stated by Kohlbrügge (1890), but just adjoining its termination.

The same may be said of the part of the coracobrachialis medius that lies distal to the point of piercing. This may reach barely to the middle of the humerus (as in *Aotus*), or it may continue well down the entepicondyloid ridge, an arrangement that is often or usually the case in those mammals having an entepicondylar foramen (as in *Tarsius*, *Nycticebus*, and *Galago*). There is no justification

for calling this longer type of muscle a *pars longa*, for it is apparently strictly homologous with the shorter type. And here lies the ambiguity. It is usually impossible to tell whether an author, using the term *coracobrachialis longus*, has reference merely to the part of the muscle distal to the musculocutaneous nerve (where this pierces), to that part lying distal to the middle of the humerus (where this position is occupied), or to an entirely separate slip, as hereafter defined. Furthermore, when the *coracobrachialis* is distally extensive one should exercise great care in dissecting the insertion free from a possible *epitrochleo-anconeus*. Where the statement is made that the former continues quite to the epicondyle we are suspicious that the two have not been properly differentiated—an error very easy to make.

When the *coracobrachialis medius* is not pierced by the musculocutaneous nerve the muscular belly is usually not separable into two distinct parts. If piercing does occur, there may be complete separation or only partial.

The portion of the *coracobrachialis* termed *pars longa* has caused us much perplexity, as explained above, for the reason that it is often impossible to be sure of the exact conditions found by an author. It is certain that frequently nothing was meant but an unusually long *pars media*, while it seems equally apparent that such authors as Wood and Parsons applied the same term indiscriminately to two different structures. Our attention was focused on this point by finding upon the right side of a chimpanzee a rather slender anomalous muscle that arose from the coracoid dorsally adjacent to the short biceps origin, and in a position corresponding to the more usual dorsal border of the *coracobrachialis medius*. This muscle was superficial to all others but the *dorsoepitrochlearis*, and maintained this position, by a slender tendon, quite to the entepicondyle, thus passing superficial to the median nerve. Its exact homology we can not state. It is probably a derivative of the primitive *coracobrachialis*, but the question whether it is a relic of a muscle invariably present in some remote ancestor, or whether an anomalous variation without particular phylogenetic significance, can not now be answered, for the reason that although a precisely similar structure has been reported and figured in widely unrelated mammals, we do not know whether it is invariably present in all individuals of those species.*

*This superficial portion of the *coracobrachialis* was very probably included in the ground plan of the brachial flexors of tetrapod vertebrates. Thus Humphry (1872) states in regard to the *coracobrachialis* that "in Amphibians, Reptiles, and Monotremes there is commonly a third segment, an inferior *coracobrachialis*, which extends to the ulnar condyle; and the brachial artery with the median nerve passes between it and the middle *coracobrachialis*" (p. 158). Judged from its superficial position in respect to the median nerve, this muscle described by Humphry may well be considered as homologous to the superficial *coracobrachialis* of our chimpanzee.

The muscular slip described by Fick (1925) in his chimpanzee "Tschege" is very probably homologous to the muscle in our animal. [In Fick's animal it had a tendinous origin from the upper part of the coracobrachialis (medius) and passed over the brachial vessels and nerves to insert on the anterior border of the dorsoepitrochlearis (sive latissimo-tricipitalis).]

For the reason that the term "coracobrachialis longus" has been so loosely and ambiguously applied, we prefer to discard this name completely and to call this slip, clearly worthy of a distinctive appellation, a coracobrachialis superficialis, to designate a muscle from the coracoid to the medial epicondyle that bridges over and passes superficial to all the brachial nerves and other muscles, except the dorsoepitrochlearis. We can, for the present, be certain that it has been found only in those mammals for which adequate illustrations have been presented, or else in those rare instances when an author has stated specifically that the muscle is entirely superficial to the median nerve.

Parsons (1898) gave a considerable number of genera in which he found that "the longus is best developed," but on the same page mentioned that the only instance in which he had found the muscle superficial to the median nerve was in the tree porcupine *Sphingurus*, for which he gave a good illustration. Likewise Wood (1867) had a figure of *Ornithorhynchus*, which seems to have had a similar arrangement. But the same author presented another figure in which this muscle is indubitably assigned to man, in which he stated that this "slip is not uncommonly found." There would seem to be some serious question here. Le Double (1897) lists but one certain instance of its occurrence in man, and it is almost certain that had it been found in any instance by a student of the department of anatomy of the Johns Hopkins University Medical School during the past 15 years the fact would have been called to the attention of one of the staff. During this time several hundred cadavers have been dissected, and no gross anatomist now on the faculty has ever seen it in man.

M. brachialis.—Whether the ideally primitive brachialis actually consisted of a single muscle going to both radius and ulna or of two slips, the evidence seems to point to the probability that the condition of two distinct slips is more primitive than that of complete fusion, as now often found in man and other mammals. The insertion in mammals is usually upon the ulna, occasionally upon the radius, and rarely on both antibrachial bones (Leche). In such a basically primitive primate as *Tarsius* there was in one specimen (*T. philippinensis*?) a lateral head from the surgical neck of the humerus entirely distinct from a medial head, arising just distal to

and partly medial to the deltoid insertion. In *Galago* the origins were similar, but the two heads were not clearly separable, which may have been partly attributable to the poor condition of the alcoholic specimen. Broadly speaking, this is the general condition in many of the lower mammals, such as insectivores and rodents. A more advanced type, as typified in anthropoid apes and some of the monkeys, is either for the lateral head to originate a trifle above the termination of the deltoid insertion, and for the medial head to begin just below this point, or else for the origin of the two to form a V partly embracing the end of the deltoid. Very often, both in man and other primates, the brachialis is partly separable longitudinally (for example, in *Pan*, *Papio*, *Saimiri*, *Aotus*, and *Nycticebus*) downward from the apex of the deltoid insertion. It is clear that its logical treatment should call for the recognition of a pars lateralis and a pars medialis. Each part is served by branches of the musculocutaneous nerve, but frequently the lateral head receives in addition a fine twig of the radial nerve, indicating that with this head of the brachialis there may at times be incorporated some relatively slight element originally derived from the extensor complex. Occasionally the muscle may be represented almost entirely by the medial head, as in our gibbon (*Hylobates*).

In some human cases the brachialis may likewise be almost completely separated into distinct superficial and deep layers as far as the tendon. It is the lateral portion of this deep layer that is frequently innervated by the radial nerve. At times it is separable from the remainder of the muscle as a more or less distinct slip that joins the main tendon just before insertion on the ulna. It is not uncommon to find this lateral portion of the brachialis fused superficially with the inner border of the brachioradialis. This union may be so intimate as completely to bridge over the radial nerve. These variations suggest that the fibers of the extensor element incorporated with the pars lateralis of the brachialis are derived from the brachioradialis rather than from the adjacent triceps complex. This view is shared by Paterson (1919).

The only other primate in which we have encountered any radial innervation of the brachialis is *Pygathrix*. In this animal brachialis and brachioradialis were completely fused superficially, bridging over the radial nerve. The lateral portion of the brachialis was innervated by both musculocutaneous and radial twigs, but the part served by the latter element was not differentiated as a separate slip.

In our dissections all nerves were traced to their emergence from the plexus, without, however, particular attention being paid to their finer variations. A few of the more interesting details may here be mentioned.

We found some variation in the exact manner in which the coracobrachialis is innervated. In some animals (as *Galago* and *Nycticebus*) the entire muscle (both profundus and medius) was served by branches directly from the musculocutaneous nerve. Sometimes, however, the nerve to the coracobrachialis profundus was derived not from the musculocutaneous nerve proper but from another portion of the plexus. Such an arrangement occurred in *Papio*, in *Tarsius* (*philippinensis*?),⁵ and in *Aotus* (No. 237). In both the *Papio* and the *Tarsius* the profundus was innervated by a branch from the lateral head of the median nerve just below the point where the musculocutaneous nerve diverged from the lateral cord of the plexus. According to Kohlbrügge (1897) both Westling and Höfer likewise found the coracobrachialis innervated by the median nerve in their orangs. This does not indicate a heterotopic innervation from the median nerve proper, but implies that certain fibers normally carried in the trunk of the musculocutaneous may at times continue for a space with those of the median. In the *Aotus*, on the other hand, the profundus received a nerve branch from the plexus proximal to the origin of the musculocutaneous nerve. It is, of course, well known that in man the nerve to the coracobrachialis frequently does not issue from the musculocutaneous nerve, but instead has an independent origin from the seventh (or seventh and sixth) cervical nerves. This indicates that these nerve fibers, usually carried with the musculocutaneous, at times become independent proximal to the formation of that trunk. This is just the opposite to the arrangement in *Papio* and *Tarsius* (*philippinensis*?). Bolk (1902) also found a separate nerve for the coracobrachialis medius in the orang-utan and *Midax rosalia*, and for the coracobrachialis profundus in *Cynocephalus babuin*. In the specimen of spider monkey (*Ateles geoffroyi*) we found that at the upper third of the brachium the median nerve sent a branch to join the terminal division of the musculocutaneous nerve, which then ended in the substance of the brachialis muscle. At the same point was the sole origin, from the median, of the lateral antibrachial cutaneous nerve. In this case, therefore, the musculocutaneous nerve carried no cutaneous fibers. This arrangement may possibly be the rule for the spider monkey, for Bolk likewise found in *Ateles belzebuth* that the n. cutaneus antibrachii lateralis arose only from the median nerve, the musculocutaneous nerve terminating in the brachialis muscle. A branch from the median to musculocutaneous was also encountered in the baboon (*Papio*), the langur (*Pygathria*), and the guenon (*Lasiopyga*). In these animals the anastomosis took place in the distal third of the upper arm.

⁵ In *Tarsius saltator* the coracobrachialis profundus was innervated by a branch issuing directly from the trunk of the musculocutaneous nerve.

Anastomosis of the median and musculocutaneous nerves is not uncommon in man, but in such cases the branch is commonly from the musculocutaneous distalward to the median (Spalteholz) and more rarely vice versa, as we found in *Ateles*, *Papio*, *Pygathrix*, and *Lasiopyga*.

Bolk described anastomoses of the median and musculocutaneous nerves in many of the primates that he dissected. In some instances (as in *Colobus ursinus*, *Macacus niger*, *Cynocephalus babuin*, *C. mormon*, and *Mycetes seniculus*) the connecting branch passed from median to musculocutaneous, as we found also in *Ateles geoffroyi* and *Papio hamadryas*; in one (*Lepilemur mustelinus*) it passed in the opposite direction as is usual in man. In *Semnopithecus nasicus* both median and musculocutaneous supplied a fine branch, which joined together and innervated the coracobrachialis medius; while in *Cercopithecus albigularis* there was a twofold anastomosis of median and musculocutaneous, the upper forming a purely motor nerve to the brachialis muscle, the lower becoming the lateral cutaneous nerve of the forearm. Anastomoses of musculocutaneous and median have also been discussed by Kohlbrügge (1897) in some detail.

We found that all the brachial nerves of *Hylobates lar* were gathered within a single sheath. This led to the first impression that the musculocutaneous nerve was not present as a separate structure, the nerves to the brachial flexors seeming to issue from the median. Fortunately, however, our specimen was dissected while fresh, so that upon splitting the common sheath the separate flexor nerves could be readily demonstrated. In an embalmed specimen this arrangement might easily have led to an erroneous interpretation. Apparently the fibers of the musculocutaneous nerve in *Hylobates* exhibit considerable variability in their degree of independence of the median nerve. Kohlbrügge (1890), for example, found no separate musculocutaneous nerve in either *Hylobates syndactylus* or *H. agilis*. In both of these animals the nerves to the three brachial flexors arose as separate branches of the lateral head of the median nerve. Bolk (1902), on the other hand, found in *Hylobates mülleri*, a common trunk in the upper arm representing the united musculocutaneous, median, and ulnar nerves. Only near the elbow did this trunk divide into median and ulnar. Prior to this point there were given off from the common trunk the separate branches to the brachial flexors. In our *Hylobates lar* at least the association of the flexor nerves in the brachium was not so intimate as that described by Bolk. This author likewise found no separate musculocutaneous nerve in his chimpanzee, the brachial flexors being served

by branches issuing directly from the median. The same arrangement occurred in the chimpanzees studied by Gratiolet and by Sutton (cited by Bolk). In our chimpanzee the musculocutaneous nerve was quite a distinct entity in each arm, and the formation and proximal distribution of the entire brachial plexus agreed quite closely with the conditions usually obtaining in man. According to Bolk, if the musculocutaneous nerve does not pierce the coracobrachialis but lies medial to it, and if no blood vessels lie between it and the median nerve, there is no factor present that may hinder the ontogenetic union of the two nerve trunks. These ideal conditions for union were realized in both his chimpanzee and his gibbon. In the latter animal he regarded the union of median and ulnar nerves as an expression of the result of the narrow spatial relationships in the vessel-nerve canal on the medial side of the arm; that is, in the sulcus bicipitalis. These hypotheses are quite ingenious and exceedingly plausible, but this particular subject needs further and more detailed investigation.

We have usually obtained the innervation of the epitrochleoanconeus, and this has always been by the ulnar nerve. Hence, this slip has no relationship with the triceps group. It should never be confused, as is usually done, with the anconeus internus sometimes found (as in *Didelphis*). This triceps element is situated more upon the extensor side of the epicondyle than is the epitrochleoanconeus, at least in primates.

CONCLUSIONS

Among the primates the brachial flexors as a whole exhibit no very distinct phylogenetic trend. The variations are individual rather than generic.

There is to be noted, among the so-called higher primates, a tendency for the two heads of the biceps brachii to fuse more completely and more proximally. Supernumerary biceps heads should probably be regarded as atavistic in some instances. In others they may represent nothing more than fortuitous variations. The *lacertus fibrosus* is present more frequently in man than in other forms. Since this is probably a primitive feature, man is to be regarded as relatively unspecialized in respect to this character.

The coracobrachialis, in its most complete expression, is composed of three parts, which we prefer to call *superficialis*, *media*, and *profunda*. The first of these is present only in very rare instances. Among the gibbons, great anthropoids, and man the *pars profunda* tends toward complete disappearance. Similarly, the *pars media* exhibits a tendency to terminate its insertion farther proximally than

in the more primitive primates. The musculocutaneous nerve usually passes between media and profunda in prosimians and monkeys, but in the great anthropoids and man its customary course is one whereby it pierces the media.

Most constant of all the brachial flexors is the brachialis. In its primitive condition it was evidently entirely separable into two heads, and traces of this original condition are found even among the more advanced primates.

The epitrochleo-anconeus, while topographically a member of the brachial flexor group, is really a portion of the flexor carpi ulnaris complex. This is indicated by its constant innervation by the ulnar nerve, and never by the musculocutaneous, which is the nerve of the true brachial flexors. This small muscle apparently occurs haphazardly among the various groups of primates.

Most striking, perhaps, are the contrasting specializations of the biceps muscle in the Lorisinae, among the lemurs, and in the Hylobatidae, among the catarrhines. In all other primates this muscle normally is composed of the usual mammalian coracoid and long heads. The lorises (*Nycticebus*, *Loris*, and *Stenops*), however, normally possess but one head, of the long variety, the coracoid head being absent. A quite different and most complicated arrangement obtains in the gibbons (Hylobatidae). This in principle consists of the normal absence of the coracoid head and its replacement by one arising from the humerus. The long head is present. There are exhibited most intimate connections with surrounding muscles, such as the pectoralis major, dorsoepitrochlearis, and the forearm flexors. This produces a mechanical arrangement which is well adapted to the extreme mode of brachiation exhibited by the gibbons. This unique anatomical arrangement is clearly an extreme functional adaptation peculiar to the gibbon. In no sense can it be regarded as representing a stage in the evolution of the biceps of man and the anthropoid apes. Though this curious structure of the gibbon's biceps seems undoubtedly to be adaptive, it is apparently not a necessary outcome of the brachiating mode of locomotion, for such able and constant brachiators as *Ateles*, *Colobus*, *Pan*, and *Pongo* exhibit no trace of such an arrangement.

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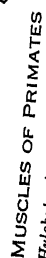
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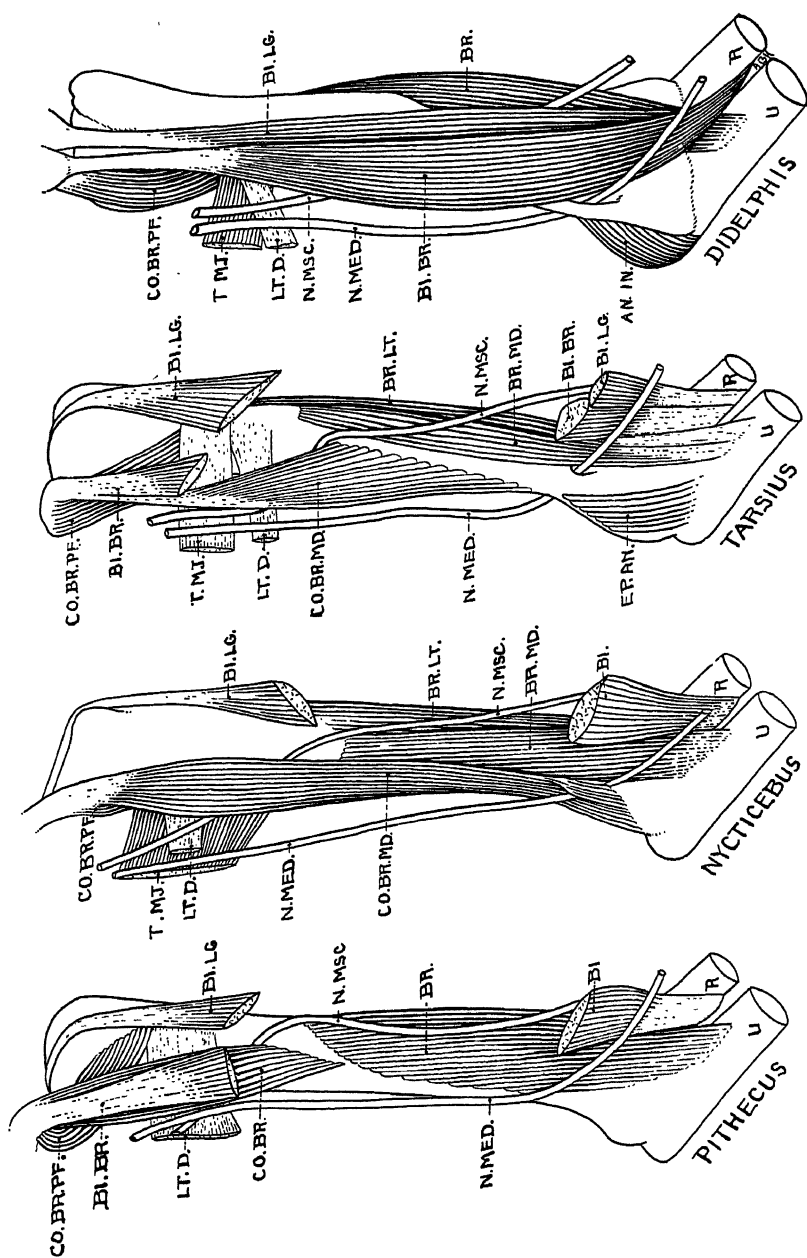
1898. Zur Anatomie von *Chiromys madagascarensis*. Denkschr. Kais. Akad. Wiss., Wien, Math.-Naturw. Cl., vol. 68, pp. 89-200.

ABBREVIATIONS USED IN PLATES

AN. IN.—anconeus internus.
BI. BR.—biceps breve.
BI. LG.—biceps longum.
BI. HM.—biceps humerale.
BR. LT.—brachialis lateralis.
BR. MD.—brachialis medialis.
CO. BR. MD.—coracobrachialis medius.
CO. BR. PF.—coracobrachialis profundus.
CO. BR. SF.—coracobrachialis superficialis.
D. EP.—dorsoepitrochlearis.
EP. AN.—epitrochleo-anconeus.
LC. FB.—lacertus fibrosus.
LT. D.—latissimus dorsi.
N. MED.—nervus medianus.
N. MSC.—nervus musculocutaneus.
N. ULN.—nervus ulnaris.
PCT. MJ.—pectoralis major.
R.—radius.
T. MJ.—teres major.
U.—ulna.
1, 2, 3.—accessory heads of the biceps brachii.
4.—common sheath of the flexor nerves.



Brachia flexors of Pan (right and left arms) and *Hylomates* (superficial and deeper aspects of left arm). For key to abbreviations see page 31.



MUSCLES OF PRIMATES AND OPOSSUM

Brachial flexors of *Pithecus*, *Nycticebus*, *Tarsius*, and *Didelphis* (all left-arm views, but the first and last have been transposed). For key to abbreviations see page 31.

UPPER CRETACEOUS FORAMINIFERA FROM TRINIDAD

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INTRODUCTION

Cretaceous foraminifera have already been described from Trinidad,¹ but further collecting and continued study of Trinidad material have increased considerably the fauna already described in this previous paper. Though the arenaceous forms are often badly distorted, on account of pressure and conditions of fossilization, the calcareous forms are usually well preserved and show much of their original detail. The entire collection represents a rather deep-water fauna that is not common in the Upper Cretaceous deposits of the general Gulf Coastal Plain of the United States, although the Velasco shale of the Tampico region represents most nearly the conditions under which these Cretaceous deposits of Trinidad were laid down. The Trinidad material, however, is very much better preserved than that of most of the Velasco shale, and it is therefore much better for detailed studies.

Many of the genera and also many of the species of the arenaceous group that are still living in the deeper waters off the coast of Trinidad are to be found in this Cretaceous material, often in considerable numbers. Such genera as *Glomospira*, *Ammodiscus*, *Ammodiscoides*, *Ammolagena*, *Hormosina*, *Saccorhiza*, and others are common in the Trinidad collections. All these genera are known living off Trinidad and usually in the same species, so that they seem to indicate that conditions of deposition for this material in the Upper Cretaceous are not very different from those that obtain off these coasts at the present day.

As already known from studies of the general Upper Cretaceous of the Gulf Coastal Plain of the United States, most of the species found are already described by various European workers from

¹ Cushman and Jarvis, Cretaceous foraminifera from Trinidad. Contr. Cushman Lab. Foram. Res., vol. 4, pp. 85-103, pls. 12-14, December, 1923.

Cretaceous deposits of similar age from Europe and elsewhere. Since d'Orbigny's work in 1840, such authors as von Hagenow, Geinitz, Reuss, Alth, Schwager, Egger, Beissel, Franke, and others have described many species from the European Upper Cretaceous. This literature has been carefully studied, together with abundant material from the Upper Cretaceous of Ireland, England, France, Holland, and Germany, and the striking resemblance of American deposits to those of Europe has been constantly emphasized. As a result very few new forms have had to be described from this Trinidad material. Occasional striking forms seem to be new, but they are the exception.

The Upper Cretaceous, especially of the Gulf Coastal Plain of the United States, is of great economic importance to the petroleum industry in geologic correlation. The entire region of the Gulf of Mexico and the Caribbean Sea was during Upper Cretaceous times an area of general deposition of the Upper Cretaceous. Though this Trinidad material is from deeper water than most of the Gulf Coastal Plain deposits, nevertheless it contains many species in common with those deposits, and this paper should therefore be useful in connection with studies now being pursued of the various Cretaceous regions of the Western Hemisphere.

The plates are from drawings of Trinidad specimens by Miss Margaret S. Moore.

In order that available literature of recent years on the Cretaceous of America may be available to students, a list of these publications is given here. Many references to these will be found in the synonymy under the various species.

Even a slight examination of the European and other literature will show that later authors have diverged widely from the original description and figures given by the earlier authors who described many of the Cretaceous species. As a result it has been felt wise in many cases to give only the first reference to a species. The following papers will be of use to anyone working with American Cretaceous material:

A BIBLIOGRAPHY OF PAPERS ON THE FORAMINIFERA (EXCLUSIVE OF ORBITOIDIDAE) FROM THE AMERICAN UPPER CRETACEOUS

BAGG, R. M.

1898. The Cretaceous foraminifera of New Jersey. U. S. Geol. Surv. Bull. 88, pp. 1-89, pls. 1-6.

CARMAN, KATHERINE.

1929. Some foraminifera from the Niobrara and Benton formations of Wyoming. Journ. Pal., vol. 3, pp. 309-315, pl. 34.

CARSEY, D. O.

1926. Foraminifera of the Cretaceous of central Texas. Univ. Texas Bull. 2612, pp. 1-56, pls. 1-8.

CHURCH, C. C.

1929. The occurrence of *Kyphopyxa* in California. Journ. Pal., vol. 3, p. 411.

CUSHMAN, J. A.

1926. The foraminifera of the Velasco shale of the Tampico Embayment. Bull. Amer. Assoc. Petr. Geol., vol. 10, pp. 581-612, pls. 15-21.
1926. Some foraminifera from the Mendez shale of eastern Mexico. Contr. Cushman Lab. Foram. Res., vol. 2, pp. 16-26, pls. 2, 3.
1927. Some characteristic Mexican fossil foraminifera. Journ. Pal., vol. 1, pp. 147-172, pls. 23-28.
1927. Some foraminifera from the Cretaceous of Canada. Trans. Roy. Soc. Canada, sect. 4, pp. 127-132, pl. 1.
1927. American Upper Cretaceous species of *Bolivina* and related species. Contr. Cushman Lab. Foram. Res., vol. 2, pt. 4, pp. 85-91, pls. 11, 12.
1927. New and interesting foraminifera from Mexico and Texas. Contr. Cushman Lab. Foram. Res., vol. 3, pp. 111-117, pls. 22, 23.
1927. Foraminifera of the genus *Siphonina* and related genera. Proc. U. S. Nat. Mus., vol. 72, art. 20, pp. 1-15, pls. 1-4. (One Upper Cretaceous species included.)
1928. The American Cretaceous foraminifera figured by Ehrenberg. Journ. Pal., vol. 1, no. 3, pp. 213-217, pls. 34-36, Jan.
1928. A Cretaceous *Cyclammina* from California. Contr. Cushman Lab. Foram. Res., vol. 4, p. 70, pl. 9, figs. 5a, b.
1928. A peculiar *Clavulina* from the Upper Cretaceous of Texas. Contr. Cushman Lab. Foram. Res., vol. 4, pp. 61, 62, pl. 8, figs. 1, 2.
1928. Fistulose species of *Gaudryina* and *Heterostomella*. Contr. Cushman Lab. Foram. Res., vol. 4, pp. 107-112, pl. 16. (Includes Cretaceous species.)
1929. *Kyphopyxa*, a new genus from the Cretaceous of Texas. Contr. Cushman Lab. Foram. Res., vol. 5, pp. 1-4, pl. 1, figs. 1-7.
1929. Some species of *Siphogenerinoides* from the Cretaceous of Venezuela. Contr. Cushman Lab. Foram. Res., vol. 5, pp. 55-59, pl. 9, figs. 5, 6, 11-15.
1930. Notes on Upper Cretaceous species of *Vaginulina*, *Flabellina*, and *Frondicularia* from Texas and Arkansas. Contr. Cushman Lab. Foram. Res., vol. 6, pp. 25-38, pls. 4, 5.

CUSHMAN, J. A., and CHURCH, C. C.

1929. Some Upper Cretaceous foraminifera from near Coalinga, California. Proc. California Acad. Sci., ser. 4, vol. 18, no. 16, pp. 497-530, pls. 36-41.

CUSHMAN, J. A., and HARRIS, REGINALD W.

1927. Some notes on the genus *Ceratobulimina*. Contr. Cushman Lab. Foram. Res., vol. 3, pp. 171-179, pls. 29, 30. (One species from the Navarro of Texas included.)

CUSHMAN, J. A., and HEDBERG, HOLLIS D.

1930. Notes on some foraminifera from Venezuela and Colombia. Contr. Cushman Lab. Foram. Res., vol. 6, pp. 64-69, pl. 9, figs. 1-13.

CUSHMAN, J. A., and JARVIS, P. W.

1928. Cretaceous foraminifera from Trinidad. Contr. Cushman Lab. Foram. Res., vol. 4, pp. 85-103, pls. 12-14.

CUSHMAN, J. A., and OZAWA, YOSHIKI.

1930. A monograph of the foraminiferal family Polymorphinidae, Recent and Fossil. Proc. U. S. Nat. Mus., vol. 77, art. 6, pp. 1-185, figs. 1, 2 (in text), pls. 1-40. (Contains numerous Cretaceous species.)

CUSHMAN, J. A., and WATERS, J. A.

1927. Some arenaceous foraminifera from the Upper Cretaceous of Texas. Contr. Cushman Lab. Foram. Res., vol. 2, pt. 4, pp. 81-85, pl. 10.
1929. Some Arenaceous foraminifera from the Taylor Marl of Texas. Contr. Cushman Lab. Foram. Res., vol. 5, pp. 63-66, pl. 10, figs. 3-7.

CUSHMAN, J. A., and WICKENDEN, R. T. D.

1928. A new foraminiferal genus from the Upper Cretaceous. Contr. Cushman Lab. Foram. Res., vol. 4, pp. 12, 13, pl. 1, figs. 1, 2.
1930. The development of *Hantkenina* in the Cretaceous with a description of a new species. Contr. Cushman Lab. Foram. Res., vol. 6, pp. 39-43, pl. 6, figs. 1-6.

JARVIS, P. W.

1929. Some notes on Cretaceous occurrences at Lizard Springs, Trinidad. Journ. Inst. Petr. Tech., vol. 15, pp. 440-442.

MOREMAN, W. L.

1927. Fossil zones of the Eagle Ford of north Texas. Journ. Pal., vol. 1, pp. 89-101, pls. 13-16 [pp. 98-100, pl. 16].

MORRISON, T. E.

1929. First authentic Cretaceous formation found on Gulf coast Salt Domes of Texas. Bull. Amer. Assoc. Petr. Geol., vol. 13, pp. 1065-1069.

REUSS, A. E.

1861. Paläontologische Beiträge. 4, Die Foraminiferen des senonischen Grünsandes von New Jersey. Sitz. Akad. Wiss. Wien, vol. 44, pp. 334-340.

TYRRELL, J. B.

1890. Foraminifera and Radiolaria from the Cretaceous of Manitoba. Trans. Roy. Soc. Canada, vol. 8, sect. 4, pp. 111-115.

WELLER, S.

1907. A report on the Cretaceous paleontology of New Jersey. Geological survey of New Jersey—Paleontology. Vol. 4, pp. 189-265, pls. 1-4.

WHITE, MAYNARD P.

- 1928-29. Some index foraminifera of the Tampico Embayment area of Mexico. Journ. Pal., vol. 2, pp. 177-215, pls. 27-29; pp. 230-317, pls. 38-42; vol. 3, pp. 30-58, pls. 4, 5.

Family ASTRORHIZIDAE

Genus RHABDAMMINA M. Sars, 1869

RHABDAMMINA DISCRETA H. B. Brady

PLATE 1, FIGURES 1, 2

In our material we have abundant broken specimens similar to those here figured. They have been referred to Brady's species, which they very closely resemble. The surface is roughened, but none of them shows any central chamber. It is worthy of note here that Franke in his work on the Cretaceous of Germany described a species as *Astrorhiza cretacea* Franke. It may be possible that our

fragmentary specimens represent the arms of some such form, but until complete specimens are obtained it may be left under *Rhabdammina*.

Family SACCAMMINIDAE

Subfamily SACCAMMININAE

Genus SACCAMMINA M. Sars, 1869

SACCAMMINA RHUMBLERI (Franke) (?)

PLATE 1, FIGURE 3

There are smooth specimens of a globular shape such as are figured here, the position of which is more or less questionable. In their general characters they resemble specimens that Franke has referred to as "*Orbulinaria rhumbleri*." These specimens of ours seem to belong to the genus *Saccammina*, but otherwise they are very close to the German ones.

Subfamily PELOSININAE

Genus PELOSINA H. B. Brady, 1879

PELOSINA COMPLANATA Franke

PLATE 1, FIGURES 4-6

Pelosina complanata FRANKE, Jahrb. kön. Preuss. Geol. Landes., vol. 32, pt. 2, p. 107, pl. 3, figs. 1a, b, 1911; Abh. Preuss. Geol. Landes., vol. 111, p. 10, pl. 1, fig. 6, 1928.

Saccammina scruposum WHITE (not *Haplophragmium scruposum* Berthelin), Journ. Pal., vol. 2, p. 183, pl. 27, fig. 5, 1928.

Test free, single, invariably crushed to a lenticular shape; wall replaced by amorphous silica, rough; aperture single, round, with short neck.

There are abundant specimens, especially in the Hobson clay from the Cretaceous of Trinidad, similar to those figured. They vary considerably in the coarseness of the material of the test, but this character is a common one in the general arenaceous group. Specimens have a definite protuberant neck with a circular aperture. The specimens are always collapsed, and the center is usually occupied by a depressed area. They seem to be identical with the specimens described and figured by Franke under the above name. They are apparently identical with the specimens referred to by White under the above reference. There is a possibility that these represent the megalospheric form of the species referred to further on in this paper as *Hormosina globulifera*. In Recent material of that species megalospheric forms are often found with a single large chamber and usually in considerable abundance. These specimens, therefore, are placed here with considerable doubt as to their true position.

Family HYPERAMMINIDAE

Subfamily HYPERAMMININAE

Genus HYPERAMMINA H. B. Brady, 1878

HYPERAMMINA ELONGATA H. B. Brady

PLATE 1, FIGURES 7, 8

Hyperammina elongata H. B. BRADY, Ann. Mag. Nat. Hist., ser. 5, vol. 1, p. 433, pl. 20, figs. 2a, b, 1878.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 86, pl. 12, fig. 1, 1928.

There are in the Cretaceous material from Trinidad a number of specimens evidently belonging to *Hyperammina* that have been already recorded in the above reference as *Hyperammina elongata* H. B. Brady. There is considerable variation in the relative quantity of cement used in the test, and consequently some of these are smoothly finished and others in which the quantity of arenaceous material is large are roughened. Similar conditions are found in Recent material. Franke notes the occurrence of a *Hyperammina* in the German Cretaceous, but does not give a definite name to his material.

HYPERAMMINA (?) sp. (?)

PLATE 1, FIGURE 9

There are a number of specimens in our material similar to that here figured, which, as one end is closed and the other open, seem to belong to this genus. All these, however, have a distinctly collapsed appearance and are more or less distorted, and so there may be some question as to the true generic position. They are given here for future reference for other workers on the group.

Subfamily DENDROPHYRINAE

Genus SACCORHIZA Eimer and Fickert, 1899

SACCORHIZA RAMOSA (H. B. Brady)

PLATE 1, FIGURES 10-12

Hyperammina ramosa H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, p. 33, pl. 3, figs. 14, 15, 1879; Denkschr. Akad. Wiss. Wien, vol. 42, p. 98, 1881; Rep. Voy. *Challenger*, Zoology, vol. 9, p. 261, pl. 23, figs. 15-19, 1884.—H. B. BRADY, PARKER, and JONES, Trans. Zool. Soc. London, vol. 12, no. 7, p. 217, pl. 41, figs. 1-4, 13, 1888.—EGGER, Abh. kön. bay. Akad. Wiss. München, vol. 18, p. 255, pl. 4, fig. 15, 1893.—GOËS, Köngl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, p. 18, pl. 4, figs. 61, 62, 1894; Bull. Mus. Comp. Zoöl., vol. 29, p. 22, 1896.—CHAPMAN, Proc. Zool. Soc. London, 1895, p. 13; Biological results fishing experiments *Endeavour* 1909-14, vol. 3, pt. 1, p. 13, 1915.—FLINT, Rep. U. S. Nat. Mus. for 1897, p. 270, pl. 11, fig. 1, 1899.—RHUMBLER,

Arch. Prot., vol. 3, p. 260, figs. 101 *a*, *b* (in text), 1903.—HERON-ALLEN and EARLAND, Trans. Linn. Soc. London, vol. 11, pt. 13, p. 220, 1916.
Saccorhiza ramosa EIMER and FICKERT, Zeitschr. Wiss. Zool., vol. 65, p. 670, 1899.—CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 1, p. 65, fig. 81 (in text), 1910; U. S. Nat. Mus. Bull. 104, pt. 1, p. 81, pl. 30, figs. 3, 4, 1918.—PEARCEY, Trans. Roy. Soc. Edinburgh, vol. 49, p. 1004, 1914.

There are numerous fragmentary specimens in the Cretaceous from Trinidad that may be referred to the above species with little question. The tubes are somewhat collapsed, but they have the characteristic irregular curvature and especially the roughened surface often carrying broken spicules. No branching specimens were found. Franke² has recorded very similar, branching fragments from the German Cretaceous as "*Rhizammima algaeformis*." White³ records a tubular fragment from the Velasco shale of Mexico as "*Rhizammima indivisa*."

Family REOPHACIDAE

Subfamily REOPHACINAE

Genus REOPHAX Montfort, 1808

REOPHAX sp. (?)

PLATE 1, FIGURE 13

Reophax sp. (?) CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 86, pl. 12, fig. 2, 1928.

No further specimens were found of the form figured here, which is the same one figured in the above reference.

Genus HORMOSINA H. B. Brady, 1879

HORMOSINA GLOBULIFERA H. B. Brady

PLATE 1, FIGURE 14

Hormosina globulifera H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, p. 60, pl. 4, figs. 4, 5, 1879; Rep. Voy. *Challenger*, Zoology, vol. 9, p. 326, pl. 34, figs. 1-6, 1884.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 86, pl. 12, fig. 3, 1928.

Specimens of this species are usually collapsed to some extent, especially the later chambers, like those in the specimen here figured. The Cretaceous specimens seem to be exactly identical with the Recent ones that occur in Atlantic waters. As already noted under *Pelosina complanata*, there is a distinct possibility that those specimens may represent the megalospheric stage of *Hormosina globulifera*. This is one of the species that give the close relationship of

² Abh. Preuss. Geol. Landes., vol. 111, p. 12, pl. 1, fig. 13, 1928.

³ Journ. Pal., vol. 2, p. 184, pl. 7, fig. 2, 1928.

this Cretaceous material to the Recent deep-water fauna of the Atlantic.

Genus NODELLUM Rhumbler, 1913

NODELLUM VELASCOENSIS (Cushman)

PLATE 1, FIGURES 15-17

Nodosinella velascoensis CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 583, pl. 20, fig. 9, 1926.—WHITE, Journ. Pal., vol. 2, p. 309, pl. 41, fig. 15, 1928.

This species has already been recorded from the Velasco shale of Mexico, where it occurs in some abundance. It is very abundant, however, in the Hobson clay of Trinidad. Though it is usually distorted, as in Mexico, specimens are so abundant that a certain proportion of them may be found that shows the normal form of the species. The proloculum is always longer than broad and somewhat pear-shaped. The following chambers in the megalospheric form increase very little if at all in diameter, while in the microspheric form they are much more numerous and increase rapidly in size as added. The wall seems to be almost entirely chitinous and nearly transparent, a fact that accounts for specimens being usually very much distorted. The other specimens of this genus are characteristic of comparatively deep water of the present oceans.

Family AMMODISCIDAE

Subfamily AMMODISCINAE

Genus AMMODISCUS Reuss, 1861

AMMODISCUS GLABRATUS Cushman and Jarvis

PLATE 2, FIGURE 1

Ammodiscus glabratus CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 86, pl. 12, figs. 6 a, b, 1928.

Test planispiral, much compressed, concave on both sides, periphery broadly curved; tubular chamber very gradually and uniformly increasing in size with succeeding coils; wall thin, composed almost entirely of cement, of a brownish color, very smooth and polished; aperture semicircular, at the end of the tubular chamber.

This species was originally described from the Lizard Springs material, and also occurs in the later collections from the Hobson clay of San Fernando. The material of the test is almost entirely pure cement, although with a considerable magnification fragmentary material of small size can be seen.

AMMODISCUS PENNYI Cushman and Jarvis

PLATE 2, FIGURES 2, 3

Ammodiscus pennyi CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 87, pl. 12, figs. 4, 5, 1928.

Test planispiral, comparatively large, periphery broadly rounded, of a few coils, the tubular chamber increasing gradually in diameter; suture deep and distinct; wall thick, conspicuously arenaceous but fairly smoothly finished; aperture semicircular at the end of the tube.

This is one of the largest species of the genus and is represented by both megalospheric and microspheric specimens. In contrast with the preceding species, the wall is very thick and has much arenaceous material. It occurs in the pit at Lizard Springs, as well as at a depth of 720 feet.

Genus AMMODISCOIDES Cushman, 1909

AMMODISCOIDES TURBINATUS Cushman

PLATE 2, FIGURES 4, 5

Ammodiscoides turbinatus CUSHMAN, Proc. U. S. Nat. Mus., vol. 36, p. 424, pl. 33, figs. 1-6, 1909; U. S. Nat. Mus. Bull. 104, pt. 1, p. 98, pl. 36, figs. 3-6, pl. 37, 1918.—RHUMBLEE, Foraminifera of the Plankton-Expedition, pt. 2, p. 388, figs. 124 a, d (in text), 1913.

The Cretaceous material referred to this species has been very carefully compared with the types in Recent dredgings, and there are no characters by which they may be separated. Except for the differences due to fossilization, it would be impossible to tell the fossil and Recent specimens apart if they were mixed. This seems to be an excellent example of the persistence of a species over a long period where unchanged ecologic conditions have prevailed.

The early whorls form a low cone on one side, and on the opposite side a distinct depression, after which the succeeding coils are practically in a single plane. The genus is already known from the Paleozoic and Recent collections, and this Cretaceous one is interesting as partially filling the gap between these. This species was originally described from dredgings in the Gulf of Mexico, so that it has persisted under similar conditions since the Cretaceous at least.

Genus GLOMOSPIRA Rzehak, 1888

GLOMOSPIRA GORDIALIS (Jones and Parker)

PLATE 2, FIGURES 6, 7

Trochammina squamata var. *gordialis* JONES and PARKER, Quart. Journ. Geol. Soc., vol. 16, p. 304, 1860.—PARKER and JONES, Philos. Trans., vol. 155, p. 408, pl. 15, fig. 32, 1865.

Glomospira gordialis CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 1, p. 99, pl. 36, figs. 7-9, 1918.—WHITE, Journ. Pal., vol. 2, p. 187, pl. 27, fig. 8, 1928.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 87, pl. 12, figs. 7, 8, 1928.

As is usual in Recent material this species shows a very considerable variation in the shape of the test, which is typically compressed in distinction from the following one, which is more or less globular in shape. Specimens appear to be identical with Recent material from this same general region in comparatively deep water.

GLOMOSPIRA CHAROIDES (Jones and Parker) var. **CORONA** Cushman and Jarvis

PLATE 2, FIGURES 8-10

Glomospira charoides (JONES and PARKER) var. *corona* CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 89, pl. 12, figs. 9-11, 1928.

Glomospira charoides (JONES and PARKER), WHITE, Journ. Pal., vol. 2, p. 187, pl. 27, fig. 8, 1928.

Variety differing from the typical in having the irregularly coiled later portion in a sort of irregular crown at the end of the test instead of coiling about the whole test as in the typical form.

This variety also occurs in the Cretaceous, Velasco shale of Mexico from which we have specimens. It is the form figured by White⁴ from the Velasco. Recent specimens that we have seen, as well as those figured, have the later portion coiling in the long axis of the test after the spiral is completed.

Genus LITUOTUBA Rhumbler, 1895

LITUOTUBA LITUIFORMIS (H. B. Brady)

PLATE 2, FIGURES 11 a, b

Trochammina lituiformis H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, p. 59, pl. 5, fig. 16, 1879.

Lituotuba lituiformis RHUMBLER, Nachr. Königl. Ges. Wiss. Göttingen, p. 84, 1895; Arch. Prot., vol. 3, p. 279, figs. 128, a, b, 1908.—CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 1, p. 114, fig. 175 (in text), 1910.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 90, pl. 12, figs. 15 a, b, 1928.

The figured specimen is evidently megalospheric and may be a distinct species, but the microspheric form should be studied. The uncoiled portion is partially collapsed.

No further specimens of this species have been found in a further search of the Trinidad Cretaceous. It has been left under Brady's species for the present at least. Franke, however, has described a somewhat similar species as "*Lituotuba incertus*" from the Upper Cretaceous of Germany. Further specimens may show that Cretaceous specimens of Germany and America are identical and distinct from the Recent one.

⁴Journ. Pal., vol. 2, pl. 27, fig. 7, 1928.

Subfamily TOLYPAMMININAE

Genus AMMOLAGENA Eimer and Fickert, 1899

AMMOLAGENA CLAVATA (Jones and Parker)

PLATE 2, FIGURE 12

Trochammina irregularis var. *clavata* JONES and PARKER, Quart. Journ. Geol. Soc., vol. 16, p. 304, 1860.

Webbina clavata H. B. BRADY, Proc. Roy. Soc. Edinburgh, vol. 11, p. 711, 1882; Rep. Voy. *Challenger*, Zoology, vol. 9, p. 349, pl. 41, figs. 12-16, 1884.

Ammolagena clavata EIMER and FICKERT, Zeitschr. Wiss. Zool., vol. 65, p. 673, 1899.—CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 1, p. 68, figs. 86-89 (in text), 1910.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 90, pl. 12, fig. 14, 1928.

A single specimen of the megalospheric form is shown in the accompanying figure. There are other specimens that evidently are microspheric, in which the proloculum is much smaller and the tube much longer, as in Recent specimens. There seems to be no difference between these Cretaceous forms and Recent forms from the same general area. Specimens were found attached to *Ammodiscus pennyi*, *Glomospira gordialis*, and *Hyperammina elongata*. These show that the same general relationship of these genera was already definitely present in the Upper Cretaceous. In the present oceans *Ammolagena clavata* is often found attached to these genera and others of the arenaceous group, as well as to some of the flattened calcareous forms. This is another of the species that has kept its identity and its characters at least since Cretaceous times without any distinct change that is apparent.

Family LITUOLIDAE

Subfamily HAPLOPHRAGMIINAE

Genus HAPLOPHRAGMOIDES Cushman, 1910

HAPLOPHRAGMOIDES CORONATA (H. B. Brady)

PLATE 2, FIGURES 13-15

Trochammina coronata H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, p. 58, pl. 5, fig. 15, 1879; Rep. Voy. *Challenger*, Zoology, vol. 9, p. 340, pl. 40, figs. 10-12, 1884.

Haplophragmoides coronata CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 1, p. 99, figs. 145-147 (in text), 1910.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 90, pl. 12, fig. 17, 1928.

Trochamminoides irregularis WHITE, Journ. Pal., vol. 2, p. 307, pl. 42, fig. 1, 1928.

Trochamminoides proteus WHITE (not Karrer), vol. 2, p. 308, pl. 42, fig. 2, 1928.

The Cretaceous specimens, while most of them are distorted and collapsed, have the general characters of the Recent species that occurs often abundantly in the present ocean in this same general region. Often the color of the Recent and Cretaceous forms is very similar. It is somewhat difficult to distinguish this species from

Trochammina globigeriniformis, noted later, on account of the distortion that takes place in fossilization, resulting in some very queer-shaped specimens. The specimens described by White in the above references are probably distorted forms of this species. His *Trochamminoides irregularis* is probably the megalospheric form, and *T. proteus* the microspheric form. These may, however, be much distorted forms of *T. globigeriniformis*, and without seeing the original specimens it is difficult for one to determine this, even if it might then be possible. The distortion produced is often so great as very largely to obliterate the original form.

HAPLOPHRAGMOIDES EXCAVATA Cushman and Waters

PLATE 3, FIGURE 1

- Haplophragmoides excavata* CUSHMAN and WATERS, Contr. Cushman Lab. Foram. Res., vol. 2, pt. 4, p. 82, pl. 10, figs. 3 *a*, *b*, 1927.—CUSHMAN, Trans. Roy. Soc. Canada, sec. 4, p. 128, pl. 1, fig. 1, 1927.
Haplophragmoides sp. (?) CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 91, pl. 12, fig. 16, 1928.

This species was originally described from the Upper Cretaceous, Navarro formation of Hunt County, Tex., where it is a common species. It has also been recorded from the Upper Cretaceous of western Canada in the above reference. Its distribution is very wide, and it is one of those species that persist in leached material where many of the calcareous forms have disappeared.

HAPLOPHRAGMOIDES EGGERI Cushman

PLATE 3, FIGURES 2 *a*, *b*

- Haplophragmium fontinense* EGGER (not Terquem), Ber. nat. Regensburg, vol. 12, 1907-1909, p. 10, pl. 3, figs. 16-18, 1910.
Haplophragmoides eggeri CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 583, pl. 15, figs. 1 *a*, *b*, 1926.
Haplophragmoides cf. *subglobosum* (G. O. Sars), CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 91, pl. 12, figs. 13 *a*, *b*, 1928.

This species, described previously from the Velasco shale of Mexico, occurs in Europe, Mexico, and Trinidad, and probably elsewhere. It is somewhat variable and on account of distortion assumes various shapes.

Genus CRIBROSTOMOIDES Cushman, 1910

CRIBROSTOMOIDES TRINITATENSIS Cushman and Jarvis

PLATE 3, FIGURE 3

- Cribrostomoides trinitatensis* CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 91, pl. 12, figs. 12 *a*, *b*, 1928.

This genus has apparently not been recorded elsewhere in the Cretaceous. It is a somewhat broader, more globular form than the

Recent species and is fairly abundant in the material from Lizard Springs, but it was not found in the other collections.

Genus AMMOBACULITES Cushman, 1910

AMMOBACULITES COPROLITHIFORME (Schwager)

PLATE 3, FIGURES 4, 5

Haplophragmium coprolithiforme SCHWAGER, in Benecke's Geogn.-pal. Beiträge, vol. 1, p. 654, pl. 34, fig. 3, 1868.

Ammobaculites coprolithiforme CUSHMAN, Trans. Roy. Soc. Canada, sec. 4, p. 130, pl. 1, figs. 6, 7, 1927.

Test elongate, early portion close coiled, later chambers rectilinear, of uniform width, generally circular in section; sutures distinct, depressed; wall arenaceous but smoothly finished; aperture circular, terminal.

This species originally described from the Cretaceous of Europe has already been recorded from the Upper Cretaceous of western Canada. Identical specimens occur in the Cretaceous of Trinidad, and the striking similarity of these may be seen by comparison of the figures of the specimens of the two regions. It is quite probable that some of the European specimens referred to *Ammobaculites agglutinans* may belong to Schwager's species. The figures seem to be similar.

Subfamily LITUOLINAE

Genus CYCLAMMINA H. B. Brady, 1876

CYCLAMMINA ELEGANS, new species

PLATE 3, FIGURES 6 a, b

Description.—Test comparatively large, close coiled, periphery somewhat lobulated and subacute, or at least compressed; chambers numerous, usually 10 to 12 in the last-formed coil; sutures distinct, slightly depressed, usually sigmoid; wall smooth, distinctly arenaceous, thin, with a very even cancellated structure of the interior showing through; aperture consisting of a low curved arch at the base of the apertural face with numerous supplementary rounded openings scattered over the central portion of the apertural face, often with slightly raised borders. Length, 2; breadth, 1.25; thickness, 0.85 mm.

Holotype.—U.S.N.M. No. 73815 (Cushman Coll. No. 15280), from Upper Cretaceous, from pit at Lizard Springs near Guayaguayare, southeastern Trinidad, British West Indies.

Remarks.—This is fairly common in the Lizard Springs Cretaceous, and is especially marked by the thin outer wall and the distinct

markings of the cancellated interior, which show distinctly from the outside.

Family TEXTULARIIDAE

Subfamily SPIROPLECTAMMININAE

Genus SPIROPLECTAMMINA Cushman, 1927

SPIROPLECTAMMINA DENTATA (Alth)

PLATE 3, FIGURES 7 a, b

Textularia dentata ALTH, Haidinger's Naturw. Abh., vol. 3, p. 262, pl. 13, fig. 13, 1850.

The figured specimen shows fairly well the characters of this species described by Alth from the Upper Cretaceous of Europe. The chambers are low and broad, with the outer margins often ending in a distinct point. In some respects this species is closely allied to *S. anceps* (Reuss).

SPIROPLECTAMMINA ANCEPS (Reuss) var.

PLATE 3, FIGURES 8 a, b

In the Trinidad Cretaceous, specimens occur that are clearly and closely allied to Reuss's species. Two forms occur, one in which the sutures are distinct but not depressed or raised, and the other, figured herein, in which the sutures themselves are slightly thickened. They somewhat resemble such forms as *Textularia mexicana* Cushman, known from the Tertiary of this general region and now living in the Gulf of Mexico, and also the form described by W. Berry as *Textularia ripleysensis*. This Trinidad form differs from either of these, but material was not sufficient to warrant its being described as a distinct variety. In some respects it resembles the form described as "*Bolivina velascoensis*" from the Upper Cretaceous, Velasco shale of Mexico.⁵

SPIROPLECTAMMINA EXCOLATA (Cushman)

PLATE 3, FIGURES 9, 10

Textularia excolata CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 585, pl. 15, figs. 9 a, b, 1926.—WHITE, Journ. Pal., vol. 3, p. 30, pl. 4, figs. 1 a, b, 1929.

Test as broad as long, the sides flattened or somewhat convex; periphery, of early portion at least, acute; chambers few, the sides somewhat concave; sutures distinct on account of the thickening of the peripheral edge, the surface below being somewhat concave; wall smoothly finished.

⁵ Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 586, pl. 16, figs. 1 a, b, 1926.

This species, originally described from the Velasco shale of Mexico and later recorded by White from the same formation, occurs in the Upper Cretaceous of Trinidad, where it is fairly common in the material from Lizard Springs. A rather typical specimen is figured (pl. 3, fig. 9), as well as an extreme form (pl. 3, fig. 10), in which the excavations of the chambers are carried to an unusual degree. This particular specimen also shows the spiral early chambers to good advantage.

Subfamily TEXTULARIINAE

Genus TEXTULARIA Defrance, 1824

TEXTULARIA CONCINNA Reuss

PLATE 4, FIGURES 1, 2

Textularia concinna REUSS, Verstein. Böhm. Kreide, pt. 2, p. 109, pl. 24, fig. 54, 1845-46.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 91, pl. 13, fig. 1, 1928.

Two forms occur in the Cretaceous of Trinidad that are here referred to Reuss's species. They occur together at the same locality, but one of these is much larger than the other. The angles of the chambers, however, are similar, and one may represent the microspheric and the other the megalospheric form of the same species. The smaller specimens are very typical of this species described by Reuss from Europe.

Family VERNEUILINIDAE

Genus VERNEUILINA d'Orbigny, 1840

VERNEUILINA POLYSTROPHA (Reuss)

PLATE 4, FIGURES 3 a, b

Bulimina polystropha REUSS, Verstein. Böhm. Kreide, pt. 2, p. 109, pl. 24, fig. 53, 1845-46.—ALTH, Haidinger's Naturw. Abh., vol. 3, pt. 2, p. 265, pl. 13, fig. 19, 1850.

Verneuilina polystropha H. B. BRADY, Ann. Mag. Nat. Hist., ser. 5, vol. 1, p. 436, pl. 20, figs. 9 a-c (?), 1878.

Test elongate, slightly tapering, triserial, rounded in end view; chambers inflated, distinct, slightly longer than broad; sutures distinct, depressed; wall arenaceous, rather smoothly finished; aperture rounded at the inner margin of the last-formed chamber. Length, 0.45; breadth, 0.15 mm.

This species was described by Reuss from the Cretaceous of Germany. It occurs in the Cretaceous of America, but the Recent material usually referred to it is probably not the same.

Genus TRITAXIA Reuss, 1860

TRITAXIA PYRAMIDATA Reuss

PLATE 4, FIGURES 4 a, b

Tritaxia pyramidata REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, pp. 32, 88, pl. 1, fig. 9, 1862 (1863); Palaeontographica, vol. 20, pt. 2, p. 123, 1872-75 (1874).—BERTHELIN, Mém. Soc. Géol. France, sér. 3, vol. 1, p. 25, pl. 1, figs. 4 a-c, 1880.—CHAPMAN, Journ. Roy. Micr. Soc., p. 2, pl. 11, figs. 2 a, b, 1892.—FRANKE, Abh. geol. pal. Inst. Univ. Greifswald, vol. 6, p. 18, pl. 2, figs. 1 a-c, 1925; Abh. Preuss. Geol. Landes., new ser., vol. 111, p. 138, pl. 12, figs. 18 a-c, 1928.

This is a common species in the European Cretaceous and occurs both in the Trinidad collections and also in those of the general Coastal Plain region of the United States. It differs from *Tritaxia tricarinata* in the much greater increase in diameter toward the apertural end, that of typical *T. tricarinata* being of generally uniform width throughout. The test is triserial throughout, and the aperture becomes rounded and terminal, usually protuberant, and with a slight lip.

Genus GAUDRYINA d'Orbigny, 1839

GAUDRYINA FILIFORMIS Berthelin

PLATE 4, FIGURE 5

Gaudryina filiformis BERTHELIN, Mém. Soc. Géol. France, sér. 3, vol. 1, p. 25, pl. 1 (24), figs. 8a-d, 1880.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 92, pl. 13, fig. 2, 1928.

In the Lizard Springs material, typical slender specimens of this species occur. The small, very elongate, slender test and the considerable length of the early triserial stage will distinguish it. It is widely distributed in the Cretaceous of various parts of the world.

GAUDRYINA RUGOSA d'Orbigny

PLATE 4, FIGURES 6 a, b

Gaudryina rugosa D'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, p. 44, pl. 4, figs. 20, 21, 1840.—REUSS, Verstein. Böhm. Kreide, pt. 1, p. 38, pl. 12, figs. 15, 24, 1845-46; in Geinitz, Grundr. Verstein., p. 667, pl. 24, fig. 69, 1845-46; Sitz. Akad. Wiss. Wien, vol. 18, p. 244, pl. 5, fig. 61, 1856.—FRANKE, Abh. geol. pal. Inst. Univ. Greifswald, vol. 6, p. 14, pl. 1, fig. 19, 1925; Abh. Preuss. Geol. Landes., new ser., vol. 111, p. 141, pl. 13, fig. 2, 1928.

Testularia agglutinans W. BERRY (not d'Orbigny), in Berry and Kelley, Proc. U. S. Nat. Mus., vol. 76, art. 19, p. 3, pl. 2, fig. 1, 1929.

Test elongate, tapering, greatest breadth toward the apertural end, periphery broadly rounded, early triserial portion usually much reduced, but the change to the biserial stage very abrupt; chambers numerous, usually distinct in the biserial portion, indistinct in the triserial portion, very slightly inflated in the later development:

sutures becoming more distinct in the later portion, straight, very slightly oblique; wall rather coarsely arenaceous but usually fairly smoothly finished; aperture in the ordinary specimens, narrow, at the inner margin of the chamber with distinct lobular projections at the sides, in very long specimens the aperture tending to be somewhat higher. Length, 0.5–1 mm.

This is a very common species in the Cretaceous in Europe and America and probably in Australia. There is considerable variation in the microspheric and megalospheric forms, the former reaching a much greater size.

GAUDRYINA RETUSA Cushman

PLATE 4, FIGURES 7–10

Gaudryina retusa CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 588, pl. 19, figs. 10 *a*, *b*, 1926.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foramin. Res., vol. 4, p. 92, pl. 13, figs. 3, 4, 1928.—WHITE, Journ. Pal., vol. 2, p. 313, pl. 42, figs. 8, 9, 1928.

Verneuilina sp. (?) CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 587, pl. 16, figs. 12*a*, *b*, 1926.

Verneuilina rotunda WHITE, Journ. Pal., vol. 2, p. 310, pl. 42, figs. 5 *a*, *b*, 1928.

Test fairly large, stout, nearly circular in transverse section, composed of few chambers, early ones triserial, later ones biserial; chambers distinct, somewhat inflated; sutures distinct, in the later portion slightly depressed; wall arenaceous but rather smoothly finished; aperture comparatively small, low.

White described a small form as *Verneuilina rotunda*. He also records *Gaudryina retusa* from the Upper Cretaceous of Mexico, and the range of his *V. rotunda* is included in his table in the range of *G. retusa*. It is very probable that the *Verneuilina* is only the young stage, perhaps of the microspheric form of *G. retusa*. The early triserial stages of *Gaudryina* and *Olavulina* have often been described as species of *Verneuilina* in the literature.

GAUDRYINA INDENTATA Cushman and Jarvis

PLATE 4, FIGURE 11

Gaudryina indentata CUSHMAN and JARVIS, Contr. Cushman Lab. Foramin. Res., vol. 4, p. 92, pl. 13, fig. 7, 1928.

Test somewhat elongate, tapering from the subacute initial end, the sides of the adult nearly parallel, circular in transverse section; chambers numerous, early ones triserial, adult biserial, the middle portion of each chamber indented and the sutures raised in rounded ridges; wall arenaceous but smoothly finished; aperture small, semi-circular, at the base of the inner margin of the last-formed chamber. Length, 0.5; diameter, 0.4 mm.

This species is peculiar in having depressed chambers. The same form occurs in the Upper Cretaceous of the Velasco shale of Mexico.

GAUDRYINA OXYCONA Reuss

PLATE 5, FIGURES 1, 2

Gaudryina oxycona REUSS, Sitz. Akad. Wiss. Wien, vol. 40, p. 229, pl. 12, figs. 3 *a-c*, 1860; vol. 46, p. 33, 1862 (1863).—FRANKE, Abh. geol. pal. Inst. Univ. Greifswald, vol. 6, p. 15, pl. 1, figs. 20 *a, b*, 1925.—CUSHMAN and CHURCH, Proc. California Acad. Sci., ser. 4, vol. 18, no. 16, p. 501, pl. 36, figs. 3, 4, 1929.

Test elongate, conical, tapering, nearly circular in transverse section; very early chambers triserial, later ones biserial; sutures distinct, slightly depressed, nearly at right angles with the periphery; wall finely arenaceous, very smoothly finished; aperture elongate, low, at the inner median margin of the chamber in a decided depression. Length, 0.55–1.25; breadth, 0.3–0.75 mm.

This is a widely distributed and well-characterized species. It is known from the California Cretaceous and occurs also in the Velasco shale of Mexico and in the Cretaceous of the Gulf Coastal region of the United States.

GAUDRYINA LAEVIGATA Franke var. PYRAMIDATA Cushman

PLATE 5, FIGURE 3

Gaudryina laevigata FRANKE var. *pyramidata* CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 587, pl. 16, figs. 8*a, b*, 1926.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 92, pl. 13, fig. 6, 1928.—WHITE, Journ. Pal., vol. 2, p. 313, pl. 42, fig. 7, 1928.

Test differing from the typical in the stouter form, the early portion more pyramidal than the type; the periphery, instead of rounded and convex, slightly concave.

This variety is a common one in the Cretaceous of America and is already described from the Velasco shale of Mexico and from this Trinidad material. It occurs widely distributed in the Upper Cretaceous of the Gulf Coastal Plain of the United States.

Genus CLAVULINA d'Orbigny, 1826

CLAVULINA TRILATERA Cushman

PLATE 5, FIGURE 5

Clavulina trilatera CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 588, pl. 17, fig. 2, 1926; Journ. Pal., vol. 1, p. 149, pl. 28, fig. 1, 1927.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 93, pl. 13, fig. 8, 1928.

Test large, elongate, sides parallel for most of their length, slightly contracted at each end, entire test triangular in transverse section, the periphery rounded, the sides concave; chambers numerous, the early ones triserial, later ones forming the larger part of the test, uniserial; sutures very slightly if at all depressed, somewhat indistinct; wall coarsely arenaceous but very smoothly finished; aperture terminal, circular, with a very slight neck.

This species is apparently very abundant in the Gulf Coastal Cretaceous of the United States. The original figures show only the megalospheric form, which has nearly parallel sides and comparatively few chambers. The microspheric form is much larger and increases rapidly in diameter toward the apertural end, but usually occurs with the megalospheric form. The surface is usually smoothly finished, and quite different from the following species. It was originally described from the Upper Cretaceous, Velasco shale of Mexico and is common in the Cretaceous of Texas, Arkansas, and Tennessee but rare in this deeper-water material from Trinidad.

CLAVULINA ASPERA Cushman

PLATE 5, FIGURE 4

Clavulina trilatera CUSHMAN var. *aspera* CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 589, pl. 17, fig. 3, 1926.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 93, pl. 13, fig. 5, 1928.—WHITE, Journ. Pal., vol. 2, p. 315, pl. 42, fig. 14, 1928.

This species was originally described as a variety of *Clavulina trilatera*. A further study of these forms from Mexico, Trinidad, and the general Gulf Coastal region of the United States seems to show that the two are distinct species. *C. aspera* always seems to have a rough surface, and in the typical form the sides are nearly parallel, although they may be somewhat more flaring in the microspheric form. Such specimens are rare in Trinidad, but the following variety is much more common.

CLAVULINA ASPERA Cushman WHITE, new variety

PLATE 5, FIGURES 6-8

Clavulina trilatera WHITE (not Cushman), Journ. Pal., vol. 2, p. 315, pl. 42, fig. 13, 1928.

Description.—Differs from the typical in the shape of the test, which in the megalospheric form has the triangular portion confined to the early portion of the test after which a series of rounded chambers of nearly uniform size is developed, in the microspheric form, with the triangular form continued throughout or becoming quadrangular in section, test increasing gradually in diameter to the apertural end; wall roughened.

Holotype of variety.—U.S.N.M. No. 73816 (Cushman Coll. No. 15306), from Upper Cretaceous of pit at Lizard Springs, near Guayaguayare, southeastern Trinidad, British West Indies.

Remarks.—This variety is very common in the Trinidad material but is not well developed in the Upper Cretaceous of the United States, although it does occur in Mexico.

CLAVULINA CHITINOSA, new species

PLATE 5, FIGURES 9-11

Description.—Test elongate, slender, the early triserial portion often being of slightly greater diameter than the later uniserial portion; chambers numerous, fairly distinct; sutures distinct, depressed, especially in the last-formed part of the uniserial portion; wall almost entirely chitinous, clear, and translucent, very smooth; aperture terminal, with a slight neck and lip. Length, up to 1; diameter, up to 0.3 mm.

Holotype.—U.S.N.M. No. 73817 (Cushman Coll. No. 15315), from Upper Cretaceous of pit at Lizard Springs, near Guayaguayare, southeastern Trinidad, British West Indies.

Remarks.—This is a peculiar form evidently representing deep-water conditions, where the wall of the test becomes almost entirely pure chitin. As a result of this type of wall, specimens are usually much distorted, but the figures will give the general appearance of the species.

Family SILICINIDAE

Genus RZEHAKINA Cushman, 1927

RZEHAKINA EPIGONA (Rzehak) var. LATA Cushman and Jarvis

PLATE 6, FIGURES 1 a, b

Rzehakina epigona (RZEHAK) var. *lata* CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 93, pl. 13, figs. 11 a, b, 1928.

Test differing from the typical in the broader, nearly circular form and the much more prominent appearance of the last coil, forming almost a rounded carina about the periphery. This is the commonest form in the collection. Some young specimens show the early coils making a flattened test before the lateral thickenings are added.

This variety is more rounded and much larger than the form found in the Velasco shale of Mexico. In addition to the Lizard Springs locality, it is abundant in the Hobson clay from San Fernando, Trinidad.

Family TROCHAMMINIDAE

Subfamily TROCHAMMININAE

Genus TROCHAMMINA Parker and Jones, 1860

TROCHAMMINA GLOBIGERINIFORMIS (Parker and Jones)

PLATE 6, FIGURES 2-5

Lituola globigeriniformis PARKER and JONES, Phil. Trans., vol. 155, p. 407, pl. 15, figs. 46, 47, pl. 17, figs. 96-98 ?, 1865.

Haplophragmium globigeriniforme CARPENTER, The microscope, ed. 6, p. 561, figs. 320 a, b (in text), 1881.

Trochammina globigeriniformis CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 1, p. 124, figs. 193-195 (in text), 1910.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 95, pl. 13, figs. 12 a, b, 1928.

There are numerous excellent specimens of this species in the collection from Trinidad. Many specimens are crushed, but a number of them are in their original form like the figured one. These crushed forms are common both at Lizard Springs and in the Hobson clay from San Fernando, Trinidad. The remarks already made under *Haplophragmoides coronata* may be applicable to this species as well.

TROCHAMMINA TRINITATENSIS Cushman and Jarvis

PLATE 6, FIGURES 6 a-c

Trochammina trinitatensis CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 95, pl. 13, figs. 13 a-c, 1928.

Test nearly circular in dorsal view, biconvex from the periphery, trochoid, somewhat keeled, slightly umbilicate on the ventral side; chambers numerous, 12 or more in the final whorl, not very distinct except for the slight collapse of the wall; central portion of the dorsal side showing the spiral suture slightly depressed; the sutures of the ventral side nearly radial, slightly curved, depressed; wall arenaceous with numerous angular fragments and much cement; aperture elongate, ventral, at the base of the chamber. Diameter, 0.4; thickness, 0.2 mm.

This is a striking species, appearing at first glance something like an *Anomalina* but having an arenaceous test, which is easily collapsed.

Family LAGENIDAE

Subfamily NODOSARIINAE

Genus ROBULUS Montfort, 1808

There are numerous species of the Lagenidae in the Cretaceous of Trinidad, nearly all of which have already been described from the Cretaceous of Europe. An examination of the literature shows how

later authors have deviated from the type of the species until the later determinations show little relationship to the original. For this reason, in many cases, only the first reference is given in the synonymy.

ROBULUS WILLIAMSONI (Reuss)

PLATE 6, FIGURES 7 *a*, *b*

Oristellaria williamsoni REUSS, Sitz. Akad. Wiss. Wien, vol. 44, pt. 6, p. 327, pl. 6, figs. 4 *a*, *b*, 1861 (1862).—CUSHMAN and CHURCH, Proc. California Acad. Sci., ser. 4, vol. 18, no. 16, p. 503, pl. 36, figs. 13, 14, 1929.

The specimen figured here is very close to the typical form figured and described by Reuss from the Cretaceous of Germany. It has a distinct keel, few chambers, depressed and slightly curved sutures, and a smooth surface. The apertural face is distinctly concave with raised edges.

ROBULUS OLIGOSTEGIA (Reuss)

PLATE 6, FIGURES 8, 9

Oristellaria oligostegia REUSS, Sitz. Akad. Wiss. Wien, vol. 40, p. 213, pl. 8, fig. 8, 1860; vol. 46, pt. 1, p. 93, pl. 13, figs. 2 *a*, *b*, 1862 (1863).

This is a very thick species with a few tumid chambers, the later ones showing a slight tendency to uncoil. The aperture is slightly protuberant.

ROBULUS STERNALIS (Berthelin)

PLATE 6, FIGURES 11 *a*, *b*

Oristellaria sternalis BERTHELIN, Mém. Soc. Géol. France, sér. 3, vol. 1, p. 51, pl. 3 (26), figs. 2 *a*, *b*, 1880.

This species may be distinguished from *R. williamsoni* by the distinctly umbonate character of the test. The angle of the sutures is very different in the two species, as are also the shape and form of the chambers.

ROBULUS TRINITATENSIS, new species

PLATE 6, FIGURES 10 *a*, *b*

Description.—Test close coiled, compressed, periphery slightly keeled; chambers fairly distinct, 6 to 8 in number in the adult, not inflated; sutures fairly distinct, strongly curved, continuing into the umbilical region, strongly limbate, but not raised; wall ornamented by a series of obliquely curved costae, toward the periphery gradually becoming nearly parallel to the outer edge of the test, and continuous over the chambers; aperture at the peripheral angle, with a supplementary elongate opening in the median line of the ventral face. Length, 0.5; breadth, 0.4; diameter, 0.2 mm.

Holotype.—U.S.N.M. No. 73818 (Cushman Coll. No. 15316), from Upper Cretaceous of pit at Lizard Springs near Guayaguayare, southeastern Trinidad, British West Indies.

Remarks.—This is a very interesting and unique species with its peculiar ornamentation, the heavy costae of the surface forming a continuous spiral independent of the individual chambers.

ROBULUS SUBALATUS (Reuss)

PLATE 7, FIGURES 1, 2

Cristellaria subalata REUSS, Denkschr. Akad. Wiss. Wien, vol. 7, pt. 1, p. 68, pl. 25, fig. 13, 1854; Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, p. 76, pl. 8, fig. 10, pl. 9, fig. 1, 1862 (1863).

The figured specimens may be referred to this species described by Reuss from the Cretaceous of Europe. Plate 7, Figure 2, shows the more typical form in which the sutures are somewhat raised above the general surface of the test. Otherwise the general form and shape of the chambers are similar, and both specimens are marked by a very broad thin keel. Length, 1.25; breadth, 0.9; thickness, 0.5 mm.

ROBULUS MACRODISCUS (Reuss)

PLATE 7, FIGURES 3 *a*, *b*

Cristellaria macrodisca REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, p. 78, pl. 9, figs. 5 *a*, *b*, 1862 (1863).—BERTHELIN, Mém. Soc. Géol. France, sér. 3, vol. 5, p. 48, pl. 3, figs. 6–11, 1880.

Lenticulina macrodisca WHITE, Journ. Pal., vol. 2, p. 198, pl. 28, fig. 7, 1928.

Close coiled specimens, with a very large prominent umbo and an acute periphery, which is occasionally slightly keeled, occur in the Cretaceous of Trinidad and may be referred to Reuss's species. They are distinctly of the *Robulus* type, with a very prominent supplementary apertural slit as shown in the figure herein. The measurements of the figured specimen are: Length, 1.2; breadth, 1.1; thickness, 0.55 mm.

ROBULUS DISCREPANS (Reuss)

PLATE 7, FIGURES 4 *a*, *b*

Robulina discrepans REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, p. 78, pl. 9, figs. 7 *a*, *b*, 1862 (1863).

Forms similar to that figured here are referred to Reuss's species described by him from the Upper Cretaceous of Europe. Similar ones occur in the Trinidad material. A comparison of our figured specimen with the type given by Reuss will show the very great similarity in the two. The chambers are not inflated, but gradually increase in size as added. The periphery is subacute, and the apertural face somewhat concave. The sutures are flush with the surface

and are strongly curved, continuing nearly to the periphery on the inner margin. There is a supplementary slit in the median line of the apertural face, placing this species in the genus *Robulus*, as was indicated by Reuss, who placed it in *Robulina*.

Genus LENTICULINA Lamarck, 1804

LENTICULINA NAVICULA (d'Orbigny)

PLATE 7, FIGURES 5 a, b

Cristellaria navicula D'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, p. 27, pl. 2, figs. 19, 20, 1840.—REUSS, Verstein. Böhm. Kreide, pt. 1, p. 35, pl. 12, fig. 27, 1845-46.

D'Orbigny described this species from the Cretaceous chalks of the Paris Basin, and Reuss and others have recorded it from the Cretaceous of central Europe. Our specimens from Trinidad seem to agree very well with those of Europe and may be identified with d'Orbigny's species. The chambers are distinct but not inflated, the periphery subacute, the sutures flush with the surface but strongly curved, and the apertural face convex without any supplementary slit, so that this species may be included in Lamarck's genus. There is a tendency in the later chambers toward uncoiling. The measurements of the figured specimen are as follows: Length, 0.9; breadth, 0.55; thickness, 0.4 mm.

This species is also widely distributed in the Coastal Plain region of the United States in the Upper Cretaceous.

LENTICULINA NUDA (Reuss)

PLATE 7, FIGURES 6 a, b

Cristellaria nuda REUSS, Sitz. Akad. Wiss. Wien, vol. 44, pt. 1, p. 328, pl. 6, figs. 1-3, 1861 (1862).

Lenticulina nuda CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 96, pl. 14, fig. 2, 1928.

This species, described by Reuss from the Cretaceous of Europe and recorded by various authors from the same region, is already noted by us from Trinidad. There is no supplementary aperture so far as our material shows. The species is somewhat similar to the preceding, but the apertural face is more concave and the periphery more distinctly keeled. There is a distinct tendency to uncoiling, and the chambers are lower. Our figured specimen has the following measurements: Length, 0.8; breadth, 0.4; thickness, 0.28 mm.

Genus PLANULARIA DeFrance, 1824

PLANULARIA ADVENA, new species

PLATE 8, FIGURES 1, 2

Description.—Test large, much compressed, periphery acute and slightly keeled; chambers distinct, low and broad, uniformly increas-

ing in breadth as added but with the height remaining nearly the same throughout, the later ones becoming much elongate; sutures limbate, in the early portion raised and somewhat irregularly beaded, later becoming entirely so, and in the last-formed portion even slightly depressed; wall, except for the umbilicus, which is beaded, and the raised sutures, smooth; aperture at the peripheral angle, radiate. Length, 5; breadth, 3; thickness, in the umbonal region, 0.9, at the middle of the last-formed chamber, 0.35 mm.

Holotype.—U.S.N.M. No. 73824 (Cushman Coll. No. 15317), from Upper Cretaceous of pit at Lizard Springs near Guayaguayare, southeastern Trinidad, British West Indies.

Remarks.—This is a large and striking species with a distinctive ornamentation. The greatest breadth is formed early in the development of the test in the umbonal region, after which it becomes complanate and much thinner.

Genus MARGINULINA d'Orbigny, 1826

MARGINULINA GRATA (Reuss)

PLATE 7, FIGURES 7 *a*, *b*; PLATE 8, FIGURES 3 *a*, *b*

Cristellaria grata REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, p. 70, pl. 7, figs. 14 *a*, *b*, 1862 (1863).—CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 598, pl. 19, figs. 1 *a*, *b*, 1926.

Lenticulina grata CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 96, pl. 14, fig. 3, 1928.

Test elongate, compressed, periphery rounded; chambers distinct, the early ones coiled, later ones uncoiling, of rather uniform shape increasing slightly in size and height as added; sutures distinct, limbate, flush with the surface, gently curved; wall smooth; aperture radiate, at the peripheral margin. Length, 1.1–1.2; breadth, 0.3–0.4; thickness, 0.2–0.25 mm.

This is a common Upper Cretaceous species known from numerous localities in Europe and widely distributed in America.

MARGINULINA MULTISEPTATA (Reuss)

PLATE 8, FIGURES 4 *a*, *b*

Cristellaria multiseptata REUSS, Haldinger's Naturw. Abh., vol. 4, pt. 1, p. 33, pl. 2, fig. 9, 1851; Denkschr. Akad. Wiss. Wien, vol. 25, p. 147, pl. 3, figs. 14, 15, 1865.

Test longer than broad, periphery subacute, later portion uncoiling; chambers fairly distinct, very slightly if at all inflated; sutures distinct, flush with the surface, slightly curved; wall smooth; aperture radiate, at the peripheral margin. Length, 1.2–1.4; breadth, 0.6–0.75; thickness, 0.35–0.4 mm.

The figured specimen is an unusual one, showing a great irregularity in the overlapping of the chambers, which produces an unusual arrangement of the sutures from the exterior.

MARGINULINA SCHLOENBACHI (Reuss)

PLATE 8, FIGURES 5 a, b

Oristellaria schloenbachi REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, p. 65, pl. 6, figs. 14, 15, 1862 (1863).

Test elongate, much compressed, curved, periphery rounded; chambers distinct, elongate, those of the later portion uncoiling and becoming higher and less broad; sutures distinctly curved especially toward the periphery, limbate, flush with the surface; wall smooth; aperture terminal, radiate. Length, 1.25–1.4; breadth, 0.35–0.4; thickness, 0.2–0.25 mm.

This species was originally described by Reuss from the Cretaceous of Europe, and seems to be a variable one. It has been recorded by numerous authors both from the Tertiary and as living in Recent seas.

MARGINULINA MODESTA Reuss

PLATE 8, FIGURES 6 a, b

Marginulina modesta REUSS, Sitz. Akad. Wiss. Wien, vol. 40, p. 207, pl. 7, fig. 5, 1860.—FRANKE, Verh. Nat. Hist. Ver., vol. 59, p. 275, 1912 (1913).—CUSHMAN and CHURCH, Proc. California Acad. Sci., ser. 4, vol. 18, no. 16, p. 506, pl. 37, figs. 8–10, 1929.

Test elongate, very little if at all compressed; the early chambers slightly coiled, later ones uncoiled and somewhat inflated, nearly circular in transverse section; sutures distinct, slightly depressed; wall smooth; aperture radiate, subterminal, somewhat toward the peripheral margin. Length, 1–1.2; thickness, 0.45–0.5 mm.

This is a common species in the Cretaceous of various parts of the world and has already been recorded from the Cretaceous of California, and it occurs in the Cretaceous of Trinidad and in the Gulf Coastal Plain region of the United States.

MARGINULINA BULLATA Reuss

PLATE 8, FIGURES 7, 8

Marginulina bullata REUSS, Verstein. Böhm. Kreide, pt. 1, p. 29, pl. 13, figs. 34–38, 1845–46; in Geinitz, Grundr. Verstein., p. 656, pl. 24, fig. 16, 1845–46.—FRANKE, Abh. geol. pal. Inst. Univ. Greifswald, vol. 6, p. 55, pl. 4, fig. 25, 1925; Abh. Preuss. Geol. Landes., vol. 111, p. 76, pl. 6, fig. 28, 1928.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 96, pl. 14, figs. 7, 8, 1928.—CUSHMAN and CHURCH, Proc. California Acad. Sci., ser. 4, vol. 18, p. 507, pl. 38, figs. 4–6, 1929.

Test composed of few chambers, the earlier ones close coiled, the last two or three uncoiled and globular, all chambers strongly inflated; sutures distinct, slightly depressed; wall smooth throughout; aperture in the adult terminal, radiate. Length of adult specimens, 0.75 mm. or more.

This is a widely distributed species in the Upper Cretaceous of Europe and America. The megalospheric form has fewer chambers and the early portion often consists largely of the globular proloculum; in the microspheric form the coiling is evident and the increase of the earlier chambers less rapid.

MARGINULINA HUMILIS (Reuss)

PLATE 8, FIGURE 9

Cristellaria humilis REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, p. 65, pl. 6, figs. 16, 17, 1862 (1863).—CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 601, pl. 19, fig. 8, 1926.

Marginulina humilis CUSHMAN and CHURCH, Proc. California Acad. Sci., ser. 4, vol. 18, p. 505, pl. 37, figs. 3-5, 1929.

Test elongate, subcylindrical, slightly compressed; chambers distinct, the later ones only slightly inflated, of nearly uniform shape, but increasing slightly in height as added, on account of the fact that the later chambers are less involute; sutures distinct, very slightly depressed between the later chambers; wall smooth; aperture radiate and peripheral. Length, 1.2-1.5; diameter, 0.4-0.45 mm.

This is a very common species in the Cretaceous, occurring in Europe and America already known from the Velasco shale of Mexico and from the Cretaceous of California. It occurs also in the Gulf Coastal Plain Cretaceous of the United States.

MARGINULINA JONESI Reuss

PLATE 9, FIGURES 1 a, b

Marginulina jonesi REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, p. 61, pl. 5, figs. 19 a, b, 1862 (1863).—BERTHELIN, Mém. Soc. Géol. France, sér. 3, vol. 1, p. 34, 1880.—CHAPMAN, Quart. Journ. Geol. Soc., vol. 50, p. 709, 1894; Journ. Roy. Microsc. Soc., p. 164, pl. 4, fig. 24, 1894.—SHERLOCK, Geol. Mag., vol. 1, p. 259, pl. 18, fig. 15, 1914.—NEAVEYSON, Geol. Mag., 1921, p. 462.—CUSHMAN and CHURCH, Proc. California Acad. Sci., ser. 4, vol. 18, p. 507, pl. 38, figs. 7-9, 1929.

Test elongate, early portion compressed and chambers close coiled, later becoming uncoiled; periphery acute and keeled in the early portion; later chambers nearly circular in section; sutures more or less obscured but the ornamentation of the surface, which consists of elongate costae continuing throughout the length of the test, unbroken at the sutures, terminal face smooth; aperture in the adult

terminal, radiate, with a slight neck. Length, 0.9-1; breadth, 0.35-0.6; thickness, 0.25-0.5 mm.

This species, which is common in the Cretaceous of Europe, has only been recorded in America from the Cretaceous of California. Our specimens from Trinidad are somewhat more inflated, especially in the later chambers, but the general characters of the species are fairly constant.

MARGINULINA DECORATA (Reuss)

PLATE 9, FIGURES 2 a, b

Oristellaria decorata REUSS, Zeitschr. deutsch. geol. Ges., vol. 7, p. 209, pl. 8, fig. 16; pl. 9, figs. 1, 2, 1855.

Test elongate, compressed, the periphery lobulate; early chambers coiled, later ones uncoiled and becoming narrower as they are added; sutures distinct, limbate, raised, the earlier ones broken into a series of beadlike projections, later ones nearly entire; aperture somewhat produced, at the peripheral angle. Length, 1.5-1.65; breadth, 0.6-0.8; thickness, 0.5-0.6 mm.

This is a somewhat variable species, but the figured specimens seem to be close enough to Reuss's original types to be included under his species.

MARGINULINA TRILOBATA d'Orbigny

PLATE 9, FIGURES 3, 4

Marginulina trilobata D'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, p. 16, pl. 1, figs. 16, 17, 1840.

Test elongate, the sides nearly parallel, periphery rounded; chambers distinct, rather uniform in size and shape; sutures distinct, limbate; the central portion at each side raised and thickened; wall, except for the sutural projections, smooth; aperture radiate, at the peripheral margin. Length, up to 3.5; breadth, 0.7-0.8; thickness, 0.4-0.45 mm.

The specimen figured is a megalospheric one and does not show the early coiled chambers, which are much more apparent in microspheric specimens. The raised sutures are somewhat variable in the degree of thickening, but this character is usually present in considerable degree. The types of this species were described by d'Orbigny from the Cretaceous chalks of the Paris Basin, and it is rather widely distributed in the chalky phase of the Upper Cretaceous of Europe and America.

Genus DENTALINA d'Orbigny, 1826

DENTALINA MEGAPOLITANA Reuss

PLATE 9, FIGURE 5

Dentalina megapolitana REUSS, Zeitschr. deutsch. geol. Ges., vol. 7, p. 267, pl. 8, fig. 10, 1855.

Nodosaria megapolitana FRANKE, Abh. geol. pal. Inst. Univ. Greifswald, vol. 6, p. 33, pl. 3, fig. 8, 1925.—CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 595, pl. 18, fig. 16, 1928.

Test large, fairly stout, tapering, slightly fusiform, greatest breadth developed before the last-formed chamber in the adult; chambers numerous, not inflated, distinct, of uniform shape, gradually increasing in size as added, the later ones often slightly decreasing; sutures distinct, not depressed, slightly oblique; wall smooth; aperture radiate, slightly protuberant at the inner angle of the terminal face of the last-formed chamber. Length, up to 2; breadth, up to 0.3 mm.

The figured specimen, while not typical, nevertheless may be included in this species of Reuss. The specimen is an incomplete one, and the species is found in the Trinidad Cretaceous. It has already been recorded from the Upper Cretaceous of Mexico in the Velasco shale and is common in Cretaceous deposits of the general Gulf Coastal Plain region of the United States.

DENTALINA FILIFORMIS Reuss (?)

PLATE 9, FIGURES 6, 7

The figured specimens show the early stages as well as some of the later chambers of a slender, slightly curved form which has been referred by Franke⁶ to Reuss's species. This form is fairly common in the American Cretaceous of the general Gulf Coastal Plain, as well as of Trinidad.

DENTALINA CATENULA Reuss

PLATE 9, FIGURES 8 a, b

Dentalina catenula REUSS, Sitz. Akad. Wiss. Wien, vol. 40, p. 185, pl. 3, fig. 6, 1860.

Test compressed, of a few chambers, slightly arcuate, rounded in transverse section; chambers distinct, inflated, subglobular; sutures depressed, distinct; wall smooth; aperture small, radiate, at the end of a distinct protuberance, at the peripheral margin of the chamber. Length, 0.6–0.75; diameter, 0.2 mm.

The chambers in this species are very much inflated and subglobular, and usually only a few of them make up the test. The aperture is especially protuberant.

⁶ Abh. Preuss. Geol. Landes., vol. 111, p. 9, pl. 2, figs. 19 a, b, 1928.

DENTALINA LEGUMEN (Reuss)

PLATE 9, FIGURE 9

Nodosaria legumen REUSS, Verstein. Böhm. Kreide, pt. 1, p. 23, pl. 13, figs. 23, 24, 1845-46; in Geinitz, Palaeontographica, vol. 20, pt. 2, p. 88, pl. 20, fig. 22, 1874.—FRANKE, Abh. geol. pal. Inst. Univ. Greifswald, vol. 6, p. 32, pl. 3, fig. 6, 1925.

Dentalina legumen REUSS, Haidinger's Naturw. Abh., vol. 4, pt. 1, p. 26, pl. 1, fig. 14, 1851; Sitz. Akad. Wiss. Wien, vol. 40, p. 187, pl. 3, fig. 5, 1860.—FRANKE, Abh. Preuss. Geol. Landes., new ser., vol. 111, p. 27, pl. 2, fig. 23, 1928.

Test elongate, slender, tapering, slightly curved; chambers distinct, inflated, increasing rather rapidly in size as added, apertural end much extended with an elongate neck, initial chamber rounded or with a single short spine; sutures distinct, depressed, oblique; wall smooth; aperture radiate at the end of an elongate neck. Length, 0.75-0.9; breadth, 0.1-0.2 mm.

This common European Cretaceous species occurs in Trinidad and in the various portions of the Gulf Coastal Plain of the United States.

DENTALINA CONFLUENS Reuss

PLATE 9, FIGURES 10-12

Dentalina confluens REUSS, Sitz. Akad. Wiss. Wien, vol. 44, pt. 1, p. 335, pl. 7, fig. 5, 1861 (1862).

Test elongate, slightly tapering, the early portion often somewhat compressed; later chambers becoming inflated and distinct; sutures depressed, especially in the later portion; wall ornamented by numerous rather coarse longitudinal costae, those of the early portion particularly, continuous over adjacent chambers and often somewhat oblique, later ones often broken at the sutures; aperture at the end of a distinct neck, radiate. Length, 2-2.8; diameter, 0.5-0.6 mm.

Two distinct forms are shown in the figures. The more elongate form with the somewhat twisted costae at the base is much more like the original figure of Reuss, but the other form occurs with this, and it seems that the two should be included together as variants of one species.

DENTALINA ANNULATA (Reuss)

PLATE 10, FIGURE 1

Nodosaria annulata REUSS, Geogn. Skizze Böhmen, vol. 2, pt. 1, p. 210, 1844; Verstein. Böhm. Kreide, pt. 1, p. 27, pl. 8, figs. 4, 67; pl. 13, fig. 21, 1845-46; in Geinitz, Palaeontographica, vol. 20, pt. 2, p. 85, pl. 20, figs. 19, 20, 1874.

Dentalina annulata REUSS, in Alth, Haidinger's Naturw. Abh., vol. 3, pt. 2, p. 269, pl. 13, fig. 29, 1850; vol. 4, pt. 1, p. 26, pl. 1, fig. 13, 1851.—FRANKE, Abh. Preuss. Geol. Landes., vol. 111, p. 34, pl. 2, figs. 34, 35, 1928.

Dentalina cf. *adolphina* CUSHMAN and JARVIS (not d'Orbigny), Contr. Cushman Lab. Foram. Res., vol. 4, p. 97, pl. 14, fig. 6, 1928.

Test much elongated, slender, tapering, greatest width toward the apertural end; chambers distinct, inflated, subglobular, increasing rather uniformly in size, the early ones somewhat less inflated; sutures distinct, depressed, more so between the later chambers; wall smooth; aperture radiate, terminal. Length, 0.8–1.25; diameter, 0.15–0.25 mm.

This species we have already recorded from Trinidad as *Dentalina* cf. *adolphina*. It seems to fit rather well the species described by Reuss from the Cretaceous of Europe and should be placed under his species.

DENTALINA sp. (?)

PLATE 9, FIGURE 13

The peculiar broken specimen figured is given simply that the record of it may be available for future workers on the Cretaceous of this area. It has very thick limbate sutures as one of its main characters.

DENTALINA sp. (?)

PLATE 10, FIGURE 3

The broken specimen figured has very coarse costae, which project somewhat at the base of each chamber and are in the later chambers projected as short spines. No complete specimens were found.

DENTALINA LORNEIANA d'Orbigny

PLATE 10, FIGURE 2

Dentalina lorneiana D'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, p. 14, pl. 1, figs. 8, 9, 1840.—FRANKE, Abh. Preuss. Geol. Landes., vol. 111, p. 28, pl. 2, fig. 29, 1928.

Test elongate, slightly arcuate; chambers increasing gradually in length as added until the final chamber is often twice as long as broad; sutures distinct, slightly depressed in the later portion; wall smooth; aperture terminal, radiate, very slightly projecting. Length, 1.6; diameter, 0.2 mm.

This species was originally described by d'Orbigny from the Cretaceous chalk of the Paris Basin, and it has been very widely recorded from Europe and elsewhere. It is a common species in Trinidad and in the Upper Cretaceous of the Gulf Coastal Plain of the United States.

Genus NODOSARIA Lamarck, 1816

NODOSARIA CONCINNA Reuss

PLATE 10, FIGURE 4

Nodosaria concinna REUSS, Sitz. Akad. Wiss. Wien, vol. 40, p. 178, pl. 1, fig. 3, 1860.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 97, pl. 14, figs. 5, 11, 1928.

Test elongate, composed of a few much inflated, subglobular chambers, becoming slightly longer than broad in the later chambers, the base often with a slight spine; sutures strongly depressed; wall smooth; aperture terminal, radiate, very slightly projecting. Length, 1; maximum breadth, 0.35 mm.

This species has been widely recorded from the Cretaceous of Europe, occurs in the Cretaceous of Trinidad, and is probably widely distributed in America.

NODOSARIA LIMBATA d'Orbigny

PLATE 10, FIGURE 5

Nodosaria limbata D'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, p. 12, pl. 1, fig. 1, 1840.

Test composed of a few inflated chambers, slightly separated from one another by distinct but very short connections; chambers somewhat pyriform; sutures distinct, somewhat depressed; wall smooth; aperture terminal, radiate, drawn out to a subacute point.

We have already referred to this form as *Nodosaria concinna* Reuss.⁷ A copy of this same specimen is given here, and it seems to fit d'Orbigny's species better than that of Reuss.

NODOSARIA LIMBATA d'Orbigny var. TUMIDATA new variety

PLATE 10, FIGURES 6 a, b

Description.—Variety differing from the typical in the shape of the chambers, which are somewhat conical, the greatest breadth being nearly at the base of the basal portion, very strongly truncated as shown in the figure.

Holotype of variety.—U.S.N.M. No. 73819 (Cushman Coll. No. 15321), from Upper Cretaceous of pit at Lizard Springs near Guayaguayare, southeastern Trinidad, British West Indies.

Remarks.—This is evidently closely related to d'Orbigny's species, as there are intermediate forms present. A similar intermediate form between this variety and the typical is figured from the Velasco shale.⁸

NODOSARIA LIMBATA d'Orbigny var. BASIORNATA new variety

PLATE 10, FIGURES 7, 8

Description.—Variety differing from the typical in the ornamentation of the surface, which consists of numerous subnodose projections on the swollen portion of each chamber.

⁷ Contr. Cushman Lab. Foram. Res., vol. 4, pl. 14, fig. 11, 1928.

⁸ Cushman, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 597, pl. 18, fig. 6, 1926.

Holotype of variety.—U.S.N.M. No. 73820 (Cushman Coll. No. 15319), from Upper Cretaceous of pit at Lizard Springs near Guayaguayare, southeastern Trinidad, British West Indies.

Remarks.—This variety is very distinctly marked and has the greatest width of the chamber progressively becoming nearer the base as chambers are added, but less distinctly so than in the preceding variety.

NODOSARIA MONILE v. Hagenow

PLATE 10, FIGURE 9

Nodosaria monile v. HAGENOW, Neues Jahrb. für Min., 1842, p. 568.—REUSS, Verstein. Böhm. Kreide, pt. 1, p. 27, pl. 8, fig. 7, 1845-46.—FRANKE, Abh. Preuss. Geol. Landes., vol. 111, p. 31, pl. 2, figs. 27 *a*, *b*, 1928.

Test elongate, very slightly tapering; chambers very distinct, inflated, subglobular throughout; sutures distinct, depressed especially toward the later-formed portion; wall smooth; aperture terminal, radiate, not projecting. Length, 1.5; diameter, 0.25 mm.

This species is very close to that recorded as *Nodosaria nuda*.⁹ That species, however, has the chambers becoming elongate in the adult, while in *N. monile* the chambers are subglobular throughout and show little tendency to lengthen. Our specimens are very close indeed to those figured by Franke from Germany in the above reference.

NODOSARIA ORTHOPLEURA Reuss

PLATE 10, FIGURE 10

Nodosaria orthopleura REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, p. 89, pl. 12, figs. 5 *a*, *b*, 1862 (1863).

Test very elongate, slightly tapering at each end, for most of its length with the sides parallel or nearly so; chambers numerous, not inflated; sutures fairly distinct, slightly limbate; wall ornamented by a few distinct elevated costae running from the base to the apertural end; aperture terminal, radiate.

The broken fragment shown here represents a portion of a large specimen of this species which must have measured, when complete, 8 or 10 mm. in length.

NODOSARIA PAUPERCULA Reuss

PLATE 10, FIGURES 14, 15

Nodosaria paupercula REUSS, Verstein. Böhm. Kreide, pt. 1, p. 26, pl. 12, fig. 12, 1845-46.

The two specimens figured are referred to the above species of Reuss, which he described from the Cretaceous of Germany. These

⁹ Cushman and Church, Proc. California Acad. Sci., ser. 4, vol. 18, p. 510, pl. 39, figs. 4-6, 1929.

may not represent a single species, but they are characterized by the subglobular chambers and the numerous costae, which are continuous from one chamber to another.

NODOSARIA AFFINIS Reuss

PLATE 10, FIGURE 13

Nodosaria affinis REUSS, Verstein. Böhm. Kreide, pt. 1, p. 26, pl. 13, fig. 16, 1845-46; in Geinitz, Palaeontographica, vol. 20, pt. 2, p. 83, pl. 20, fig. 12, 1874.—FRANKE, Abh. geol. pal. Inst. Univ. Greifswald, vol. 6, p. 37, pl. 3, fig. 25, 1925.—BERRY and KELLEY, Proc. U. S. Nat. Mus., vol. 76, art. 19, p. 6, pl. 1, fig. 8, 1929.

Nodosaria proaima BERRY and KELLEY (not Silvestri), Proc. U. S. Nat. Mus., vol. 76, art. 19, p. 7, pl. 1, fig. 13, 1929.

Test elongate, of variable shape in the microspheric and megalospheric forms, the former with many chambers and tapering, the greatest width near the apertural end, the latter with the chambers of nearly uniform diameter throughout; chambers distinct, inflated, especially toward the apertural end, initial end usually with a stout spine; sutures distinct, depressed, often somewhat limbate; wall ornamented by numerous (usually 13 to 15) longitudinal costae, continuous over the adjacent chambers, usually sharp and platelike; aperture radiate, terminal, with a slight projection of the apertural face. Length, up to 2 mm. or more; diameter, normally about 0.3 mm., but in extreme megalospheric forms may be as much as 0.75 mm.

This species, described from the Upper Cretaceous of Europe, is very common indeed in the Upper Cretaceous of the Gulf Coastal Plain of the United States, and apparently our specimen figured here, although incomplete, probably belongs in the same species. There is a great degree of variation in the relative size and number of chambers in the material from the Gulf Coastal Plain, although the ornamentation remains fairly constant.

NODOSARIA cf. MARCKI Reuss

PLATE 10, FIGURE 12

Nodosaria cf. marcki CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 97, pl. 14, fig. 4, 1928.

The specimen figured is the same as that given in the above reference. It is very close to a figure given by Franke from the Cretaceous of Germany.¹⁰ Very similar specimens occur also in the Velasco shale of Mexico.

¹⁰ Abh. geol. pal. Inst. Univ. Greifswald, vol. 6, pl. 3, fig. 22 a, 1925.

NODOSARIA BREVITESTA Franke

PLATE 10, FIGURE 11

Nodosaria brevitesta FRANKÉ, Abh. geol. pal. Inst. Univ. Greifswald, vol. 6, p. 42, pl. 3, fig. 37, 1925.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 97, pl. 13, fig. 10, 1928.

Franke figures from the Cretaceous of Germany a specimen which seems close to our figured one from Trinidad. It is a short, stout form with a very few remote costae continuous over the sutures. No further material has been available to check the earlier notes on this species.

NODOSARIA VELASCOENSIS Cushman

PLATE 11, FIGURES 1-4

Nodosaria fontannesii (BERTHELIN var. *velascoensis* CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 594, pl. 18 fig. 12, 1926.

Nodosaria velascoensis CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 97, pl. 13, figs. 15, 16, 1928.

Test elongate, subcylindrical, very slightly tapering, greatest width developed by the last-formed chamber, consisting of numerous chambers increasing in height as added, the last ones somewhat longer than broad, circular in transverse section; sutures only slightly depressed, ornamentation consisting of very fine longitudinal costae which in the early portion may be continuous, but over most of the test are restricted to the areas over the sutures. Length, up to 2.5; breadth, 0.3-0.4 mm.

This form was originally described from the Velasco shale of Mexico, where it was fairly common. It is also common in the Trinidad material and shows a considerable degree of variation, especially in the ornamentation of the test. The costae are usually somewhat spirally arranged, especially in the early portion, and in later chambers are often restricted to the area immediately adjoining the sutures.

NODOSARIA ASPERA Reuss

PLATE 11, FIGURE 5

Nodosaria aspera REUSS, Verstein. Böhm. Kreide, pt. 1, p. 26, pl. 13, figs. 14, 15, 1845-46.

Test somewhat elongate, tapering toward the initial end, greatest breadth at the last-formed chamber; chambers increasing rather uniformly as added, slightly involute, subglobular; sutures distinct, but only slightly depressed; wall ornamented with small, closely set spines covering the entire surface; aperture with a long, cylindrical neck projecting well out beyond the outline of the test. Length, up to 1.6; breadth, 0.5-0.55 mm.

The figured form agrees very closely with the species described by Reuss from the Cretaceous of Europe. It is not common in the Trinidad material, but specimens are well preserved.

NODOSARIA sp. (?)

PLATE 11, FIGURE 6

The figure shows the last two chambers of a species with a distinctive type of ornamentation in which there are prominent continuous costae and other smaller ones between. When more material is available this can probably be referred to one of Reuss's species already described from Europe, but until such material is available it is not desired to give it a definite specific name.

Genus PSEUDOGLANDULINA Cushman, 1929

PSEUDOGLANDULINA CYLINDRACEA (Reuss)

PLATE 11, FIGURES 7, 8

Glandulina cylindracea REUSS, Haidinger's Naturw. Abh., vol. 4, pt. 1, p. 23, pl. 1, fig. 5, 1851; Sitz. Akad. Wiss. Wien, vol. 40, p. 190, pl. 4, fig. 1, 1860; vol. 44, pt. 1, p. 307, 1861 (1862); Palaeontographica, vol. 20, pt. 2, p. 89, 1872-1875 (1874).—EGGEE, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 21, p. 84, pl. 5, figs. 19, 20, 1899.—CUSHMAN and CHURCH, Proc. California Acad. Sci., ser. 4, vol. 18, p. 511, pl. 39, figs. 8, 9, 1929.

Nodosaria cylindracea REUSS, Verstein. Böhm. Kreide, pt. 1, p. 25, pl. 13, figs. 1, 2, 1845-46.

Nodosaria (Glandulina) cylindracea CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 594, pl. 18, fig. 1, 1926.

Test composed of a few subcylindrical chambers which are distinctly involute, the final chamber often being nearly twice as long as broad; sutures distinct, very slightly depressed, slightly oblique; wall smooth; aperture terminal, radiate, slightly projecting. Length, up to 3; breadth, 0.6 mm.

This species has already been recorded from the Upper Cretaceous of California and from the Velasco shale of Mexico. It is common in many parts of Europe and occurs widely distributed in the Upper Cretaceous of the Gulf Coastal Plain of the United States.

PSEUDOGLANDULINA PARALLELA (Marsson)

PLATE 11, FIGURE 9

Glandulina parallela MARSSON, Mitth. Nat. Ver. Neu-Vorpommern. Rügen, vol. 10, p. 124, pl. 1, figs. 4 a, b, 1878.

The figured specimen may be referred to Marsson's species described from the chalk of the Island of Rügen. A similar form is figured by Franke¹¹ and referred to this same species. Such forms are common in the American Cretaceous and are widely distributed.

¹¹ Abh. Preuss. Geol. Landes., vol. 111, pl. 4, fig. 16, 1928.

PSEUDOGLANDULINA BISTEGIA (Olszewski) (?)

PLATE 11, FIGURES 10-12

Cristellaria bistegia OLSZEWSKI, Sprawozd. kom. fizyogr. Akad. umiej. Krakowie, vol. 9, p. 115, pl. 1, fig. g (error for 9), 1875.

The figured specimens show a peculiar form that may be referred to the above species with some question. Some of the specimens have a very decidedly roughened proloculum, the second chamber being smooth. The aperture in all of these specimens is somewhat broken, and its character can not be fully determined.

PSEUDOGLANDULINA sp. (?)

PLATE 11, FIGURE 13

The single specimen figured here evidently represents an ornamented species of this genus, but more material is necessary to give it a specific determination.

Genus FLABELLINA d'Orbigny, 1839

FLABELLINA RETICULATA Reuss

PLATE 11, FIGURE 15

Flabellina reticulata REUSS, Haidinger's Naturw. Abh., vol. 4, pt. 1, p. 30, pl. 1, fig. 22, 1851; Sitz. Akad. Wiss. Wien, vol. 44, pt. 1, p. 326, 1861 (1862).—OLSZEWSKI, Sprawozd. kom. fizyogr. Akad. umiej. Krakowie, vol. 9, p. 110, 1875.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 21, p. 107, pl. 13, figs. 5-7, 1890.—FRANKE, Abh. geol. pal. Inst. Univ. Greifswald, vol. 6, p. 64, pl. 5, fig. 14, 1925; Abh. Preuss. Geol. Landes., vol. 111, p. 93, pl. 8, fig. 19, 1928.—WHITE, Journ. Pal., vol. 2, p. 204, pl. 28, fig. 15, 1928.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 6, p. 32, pl. 4, figs. 18, 19, 1930.

Frondicularia reticulata BAGG, U. S. Geol. Survey Bull. 88, p. 50, pl. 3, fig. 6, 1898.—WELLER, Geol. Survey New Jersey, Paleontology, vol. 4, p. 230, pl. 2, fig. 30, 1907.—PLUMMER, Univ. Texas Bull. 2044, pp. 39, 172, pl. 2, fig. 5, 1927.

Flabellina favosa BEISSEL, Abh. Kön. Preuss. geol. Landes., vol. 3, p. 49, pl. 19, figs. 25-28, pl. 26, fig. 28, 1891.

Frondicularia cf. *interpunctata* CUSHMAN (not von der Marck), Bull. Amer. Assoc. Petr. Geol., vol. 10, no. 6, p. 593, pl. 20, fig. 6, 1926.

Test much compressed, sides nearly or quite flat, outline of test variable, periphery truncate; early portion coiled, later chambers extending back on both sides; chambers distinct; sutures distinct, raised somewhat, the surface of the test between covered by a raised network of octagonal meshes with the long axis at right angles to the sutures; aperture slightly produced.

This is a widely distributed species in Europe and America and is abundant in the Navarro formation of Texas and equivalent formations of Arkansas and Tennessee.

FLABELLINA SEMIRETICULATA Cushman and Jarvis

PLATE 11, FIGURE 14

Flabellina semireticulata CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 98, pl. 13, fig. 14, 1928.

Test rhomboid in front view, much compressed, apertural end extended; chambers and sutures obscured by the surface ornamentation, which consists of a more or less irregular reticulation, the sides of the polygonal areas raised, thin and platelike. Length, 0.6; breadth, 0.35; thickness, 0.08 mm.

This form was described by us as a new species in the above reference. It is to be suspected that it may be only a form of the preceding species, but more material is necessary to determine this point definitely.

FLABELLINA INTERPUNCTATA von der Marck

PLATE 12, FIGURE 1

Flabellina interpunctata VON DER MARCK, Verh. nat. Ver. preuss. Rheinl., vol. 15, p. 53, pl. 1, fig. 5, 1858.—REUSS, Sitz. Akad. Wiss. Wien, vol. 40, p. 216, pl. 9, fig. 1, 1860.—HERON-ALLEN and EARLAND, Journ. Roy. Micr. Soc., p. 422, pl. 8, fig. 5, 1910.—FRANKE, Bronn. Verh. Nat. Hist. Ver., vol. 59, p. 277, 1912 (1913).—CHAPMAN, Bull. Geol. Surv., Western Australia, No. 72, p. 34, pl. 10, fig. 91, 1917.—FRANKE, Abh. geol. pal. Inst. Univ. Greifswald, vol. 6, p. 64, pl. 5, fig. 13, 1925; Jahrb. preuss. Geol. Landes., vol. 48, p. 678, 1927; Abh. preuss. Geol. Landes., vol. 111, p. 92, pl. 8, fig. 17, 1928.—WHITE, Journ. Pal., vol. 2, p. 203, 1928.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 6, p. 30, pl. 4, figs. 16, 17, 1930. *

Flabellina rugosa BEISSSEL (not d'Orbigny), Abh. Kön. Preuss. geol. Landes., vol. 3, p. 47, pl. 9, figs. 20–24, 1891.

Frondicularia projecta CARSEY, Univ. Texas Bull. 2612, p. 41, pl. 6, fig. 5, 1926.

Frondicularia baudouiniana CUSHMAN (not d'Orbigny), Contr. Cushman Lab. Foram. Res., vol. 2, p. 21, pl. 3, fig. 5, 1926; Journ. Pal., vol. 1, p. 155, pl. 24, fig. 13, 1927.

Test sagittate to rhomboid in outline, much compressed, sides nearly flat, periphery truncate; early chambers coiled, later ones extending back on both sides; sutures raised and sharp, later chambers with a loop or series of loops at the apical end of the chamber; wall between the raised sutures with a series of small papillae; apertural end slightly projecting.

This is a very characteristic species with its raised, clear-cut sutures and the papillate wall. The peculiar looplike extensions in the median line in the adult are also characteristic even if the papillae are covered.

The species is very widely distributed and is naturally subject to considerable variation. The main characters, however, remain constant, and its vertical range is considerable.

FLABELLINA ELLIPTICA (Nilsson)

PLATE 12, FIGURE 2

Planularia elliptica NILSSON, Petr. Suec. form. cret., p. 11, pl. 9, figs. 21, 22, 1827.
Flabellina elliptica FRIC, Stud. Geb. Böhm. Kreide., vol. 2, p. 149, fig. 152 (in text), 1877.—FRANKE, Abh. Preuss. Geol. Landes., vol. 111, p. 91, pl. 8, figs. 14, 15, 1928.

Test somewhat rhomboid in outline, the early portion distinctly coiled; sutures distinct, slightly limbate, but hardly if at all depressed; wall very smooth. Length, 4; breadth, 3.25 mm.

The very broad, large, smooth form figured here may be referred to the above species, although the early figures are not very definite. A similar form occurs in the Cretaceous of the Gulf Coastal Plain of the United States.

Genus FRONDICULARIA Defrance, 1824

FRONDICULARIA ELONGATA White (?)

PLATE 12, FIGURE 3

Frondicularia archiaciana CUSHMAN (not d'Orbigny), Contr. Cushman Lab. Foram. Res., vol. 2, p. 21, pl. 3, fig. 4, 1926.

Frondicularia sp. (?) CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 598, pl. 20, fig. 2, 1926.

Frondicularia elongata WHITE, Journ. Pal., vol. 2, p. 205, pl. 29, fig. 3, 1928.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 98, pl. 14, fig. 1, 1928.

This species described from the Upper Cretaceous of Mexico is also found in the Trinidad collection. The figure given by White shows the costae only between the sutures, and the description reads "with longitudinal ribs crossing the interspaces" as if they were independent on the different chambers. His figure also seems to clearly indicate that the costae are independent of one another on different chambers, as will be seen especially on the left side of the specimen that the different series are not at all aligned. If the figure and description are accurate, it would seem that *F. elongata* is a synonym of *F. decheni* Reuss from the Cretaceous of Germany, and that our species figured here from Trinidad and from Mexico is another species.

The above notes are from our earlier paper. No further material has been found that will help to solve the problem of the identity of this species.

FRONDICULARIA CORDAI Reuss

PLATE 12, FIGURE 4

Frondicularia cordai REUSS, Verstein. Böhm. Kreide, pt. 1, p. 31, pl. 8, figs. 26-28, pl. 13, fig. 41, 1845-46; pt. 2, p. 108, pl. 24, fig. 38, 1845-46.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 6, p. 34, pl. 5, fig. 17, 1930.

There is a single fragment here that may be referred to Reuss's species. The surface is very finely costate. The species is known from the Gulf Coastal Plain of the United States.

FRONDICULARIA GRACILIS Franke (?)

PLATE 12, FIGURE 5

Frondicularia angusta REUSS (not Nilsson), Sitz. Akad. Wiss. Wien, vol. 40, p. 196, pl. 4, fig. 5, 1860.

Frondicularia archiaciana D'ORBIGNY var. *strigillata* BAGG (not *F. strigillata* Reuss), U. S. Geol. Survey Bull. 88, p. 47, pl. 3, fig. 5, 1898.

Frondicularia gracilis FRANKE, Abh. geol. pal. Inst. Univ. Greifswald, vol. 6, p. 50, pl. 4, fig. 9, 1925.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 6, p. 37, pl. 5, fig. 16, 1930.

The single fragment figured here is more finely ornamented than is typical of Franke's species, but until further material is obtained it is referred here.

Subfamily LAGENINAE

Genus LAGENA Walker and Jacob, 1798

LAGENA ORBIGNYANA (Seguenza)

PLATE 12, FIGURE 6

Very similar specimens of that figured here were found in the Velasco shale material in Mexico and referred to Seguenza's species. The central body of the test is smooth in distinction from the following variety.

LAGENA ORBIGNYANA (Seguenza) var.

PLATE 12, FIGURES 7 a, b

This form, with the body of the test covered with longitudinal costae, seems to be identical with a similar form already recorded¹² from the Velasco shale of Mexico.

Family POLYMORPHINIDAE

Genus GUTTULINA d'Orbigny, 1826

GUTTULINA ADHAERENS (Olszewski)

PLATE 12, FIGURES 8 a, b

Polymorphina adhaerens OLSZEWSKI, Sprawodz. kom. fizyogr. Akad. umiej. Krakowie, vol. 9, p. 119, pl. 1, fig. 11, 1875.

Guttulina adhaerens CUSHMAN and OZAWA, Proc. U. S. Nat. Mus., vol. 77, art. 6, p. 36, pl. 1, figs. 9 a-c; pl. 6, figs. 7 a, b, 1930.

¹² Cushman, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 593, pl. 17, fig. 13, 1926.

The figured specimen may be referred to this Cretaceous species, which is variable in the form of the chambers. One side is decidedly flattened, giving the test the appearance of having been attached.

Genus PSEUDOPOLYMORPHINA Cushman and Ozawa, 1928

PSEUDOPOLYMORPHINA OZAWANA, new species

PLATE 12, FIGURES 9 a, b

Description.—Test elongate, very much compressed; early chambers somewhat thicker than the later ones, which are definitely biserial; sutures raised and subnodose; wall between the sutures smooth; aperture terminal, radiate. Length, 2.5; breadth, 1; thickness, 0.5 mm.

Holotype.—U.S.N.M. No. 73821 (Cushman Coll. No. 15324), from Upper Cretaceous of pit at Lizard Springs, near Guayaguayare, southeastern Trinidad, British West Indies.

Remarks.—This is a peculiar highly ornamented species of the genus and very distinct from any other known Cretaceous form. It is named for the late Prof. Yoshiaki Ozawa, who has contributed so much to the knowledge of this family.

Genus RAMULINA Rupert Jones, 1875

RAMULINA sp. (?)

PLATE 12, FIGURES 10, 11

The two spinose forms figured here may be referred to the genus *Ramulina*, but without further material it seems rather useless to give this a definite specific name.

Family NONIONIDAE

Genus NONION Montfort, 1808

NONION CRETACEUM, new species

PLATE 12, FIGURES 12 a, b

Description.—Test closely coiled, compressed, very slightly umbilicate, periphery subacute; chambers distinct, eight making up the adult coil, of uniform shape increasing very slightly in size as added; sutures distinct, limbate, very slightly curved; wall smooth, the central umbilical region covered with a layer of clear shell material, in which are tubular spaces connecting with the umbilici, represented by lighter spaces in the clear material; aperture narrow, at the base of the last-formed chamber. Diameter, 0.65; thickness, 0.25 mm.

Holotype.—U. S. N. M. No. 73822 (Cushman Coll. No. 15327) from Upper Cretaceous of pit at Lizard Springs near Guayaguayare, southeastern Trinidad, British West Indies.

Remarks.—This is a very peculiar species of the genus, and unlike any other described form. It has very limbate sutures and a peculiar arrangement of the umbilical region, with its thickening of clear shell material pierced by irregularly curved tubular openings.

Family CAMERINIDAE

Genus OPERCULINA d'Orbigny, 1826

OPERCULINA CATENULA, new species

PLATE 12, FIGURES 13 *a*, *b*

Description.—Test broadly complanate, periphery rounded, greatest thickness in the umbonal region; chambers distinct, about 15 in the last-formed coil, of rather uniform shape and increasing somewhat in length as added; sutures distinct, limbate, raised, ornamented by numerous beadlike protuberances which are slightly elongate in the line of the suture, sutures ending in the umbonal region in a distinct boss which itself is somewhat beaded; wall between the sutures smooth. Diameter, 2.25; thickness, 0.6 mm.

Holotype.—U.S.N.M. No. 73823 (Cushman Coll. No. 15325), from Upper Cretaceous of pit at Lizard Springs near Guayaguayare, southeastern Trinidad, British West Indies.

This is one of the few species of this genus known from the Upper Cretaceous, and it seems to be a very distinctive one as developed in this Upper Cretaceous of Trinidad.

Family HETEROHELICIDAE

Genus GÜMBELINA Egger, 1899

GÜMBELINA sp. (?)

PLATE 13, FIGURES 1 *a*, *b*

There are a few very poorly preserved specimens of *Gümbelina*, which it seems unwise definitely to place under a specific name. The surface is not usually well preserved, and it may possibly be that they are reworked specimens from some older Cretaceous source.

Genus BOLIVINOIDES Cushman, 1927

BOLIVINOIDES DECORATA (Jones) var. DELICATULA Cushman

PLATE 13, FIGURE 2

Bolivina decorata CUSHMAN (not Jones), Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 19, pl. 2, figs. 3 *a*, *b*, 1926.

Bolivinooides decorata (JONES) var. *delicatula* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 2, pt. 4, p. 90, pl. 12, fig. 8, 1927; Journ. Pal., vol. 1, p. 158, pl. 28, fig. 7, 1927.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 99, pl. 14, fig. 9, 1928.

This elongate variety, which has already been recorded from the Velasco shale of Mexico, occurs in typical form in Trinidad. The ornamentation of the surface is shown in the figure, and it is quite distinct from typical *B. decorata* (Jones) as developed in Europe.

BOLIVINOIDES TRINITATENSIS Cushman and Jarvis

PLATE 13, FIGURES 3 *a*, *b*

Bolivinooides trinitatensis CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 99, pl. 14, figs. 10 *a*, *b*, 1928.

Test generally biserial, broadest near the apertural end, tapering to the subacute initial end, whole test thickening rapidly toward the apertural end, which is formed of a smooth thickened area; chambers marked by the highly ornate character of the test, consisting of thin convex platelike extensions backward from the thickened terminal face of the chamber having a deep area below, with trusslike raised costae, the areas over the chambers deeply depressed; aperture a somewhat elongate opening marking the suture which is otherwise obscured by the thickening of the apertural end of the test. Length, 0.6; breadth, 0.38; thickness, 0.2 mm.

The figured specimen, which is the holotype, does not show such a great development of the platelike extensions and the very deep excavations below them as do some of the other specimens from the same locality. This is one of the most highly ornamented species of the genus and is closely allied to *B. velascoensis* (Cushman), described from the Velasco shale of Mexico.

Genus SPIROPLECTOIDES Cushman, 1927

SPIROPLECTOIDES CLOTHO (Grzybowski)

PLATE 13, FIGURES 5, 6

Spiroplecta clotho GRZYBOWSKI, Rozprawy Wydz. mat. przyr., vol. 41, p. 283, pl. 7, fig. 18, 1901.

Spiroplecta annectens CUSHMAN (not Parker and Jones), Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 584, pl. 15, figs. 4 *a*, *b*, 1926.

Spiroplectoides clotho CUSHMAN, Journ. Pal., vol. 1, p. 159, pl. 28, fig. 6, 1927.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 101, pl. 14, figs. 13, 14, 1928.

Our specimens from Trinidad are very excellently preserved and show especially well the sutures, which are somewhat limbate. The two figures show the difference in shape and size of the microspheric and megalospheric forms. When seen separately the two might easily be mistaken for two distinct species.

Family BULIMINIDAE

Genus BULIMINA d'Orbigny, 1826

BULIMINA TRINITATENSIS Cushman and Jarvis

PLATE 13, FIGURES 4 a, b

Bulimina trinitatensis CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 102, pl. 14, figs. 12 a, b, 1928.

Test somewhat longer than broad, rounded in transverse section; chambers distinct with the lower border extended into an overhanging plate, which is marked on the upper side by an irregular network of reticulate areas, the outer angles ending in short spines; aperture elongate, comma-shaped, the apertural face smooth. Length, 0.5; diameter, 0.3 mm.

The ornamentation of this species is very distinctive and will distinguish it from any described species of the genus. The same species is apparently developed in the Gulf Coastal Plain region of the United States, or at least a very similar one occurs there.

Genus LOXOSTOMUM Ehrenberg, 1854

LOXOSTOMUM PLAITUM (Carsey)

PLATE 13, FIGURE 7

Bolivina plaita CARSEY, Univ. Texas Bull. 2612, p. 26, pl. 4, fig. 2, 1926.

Proroporus plaita CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 2, pt. 4, p. 89, pl. 12, figs. 7 a, b, 1927.

This species is now widely known from the Cretaceous of the Western Hemisphere, occurring in its typical form in the Navarro and its equivalent in the Gulf Coastal Plain region of the United States.

Family ELLIPSOIDINIDAE

Genus PLEUROSOTOMELLA Reuss, 1860

PLEUROSOTOMELLA CLAVATA Cushman

PLATE 13, FIGURES 8 a, b

Pleuromella clavata CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, no. 6, p. 590, pl. 16, fig. 5, 1926; Contr. Cushman Lab. Foram. Res., vol. 3, p. 132, pl. 25, fig. 19, 1927.—WHITE, Journ. Pal., vol. 2, p. 52, pl. 5, fig. 14, 1928.

Test somewhat fusiform, nearly circular in transverse section, greatest diameter toward the apertural end, periphery very slightly, if at all, lobulate, composed of a few chambers; the sutures distinct but not depressed; wall smooth, finely perforate; aperture at the

base of the last-formed chamber, very large, arched. Length, 0.65–1; diameter, 0.25–0.45 mm.

This species is now known from the Velasco shale of Mexico, from which it was originally described, from the Upper Cretaceous of Trinidad, and from the Gulf Coastal Plain of the United States.

Genus ELLIPSOPLEUROSTOMELLA A. Silvestri, 1903

ELLIPSOPLEUROSTOMELLA CURTA Cushman

PLATE 13, FIGURES 9, 10

Ellipsopleurostomella curta CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 590, pl. 16, figs. 6 a, b, 1926.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 102, pl. 14, figs. 18, 19, 1928.

The somewhat irregular specimens shown are possibly both forms of this species, but one of them has developed a chamber with a terminal aperture, and it may belong elsewhere.

Genus ELLIPSONODOSARIA A. Silvestri, 1900

ELLIPSONODOSARIA SUBNODOSA (Guppy)

PLATE 13, FIGURES 11–13

Ellipsoidina subnodosa GUPPY, Proc. Zool. Soc. London, 1894, p. 650, pl. 41, fig. 12.

Ellipsodosaria subnodosa NUTTALL, Quart. Journ. Geol. Soc., vol. 84, p. 95, pl. 6, fig. 20, 1928.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 102, pl. 14, figs. 15, 16, 1928.

The two forms given may represent the microspheric and megalospheric forms of the same species. The adult chambers are very similar in all the specimens.

Genus ELLIPSOGLANDULINA A. Silvestri, 1900

ELLIPSOGLANDULINA EXPONENS (H. B. Brady)

PLATE 13, FIGURES 14–16

Ellipsoidina exponens H. B. BRADY, in Jukes-Brown and Harrison, Quart. Journ. Geol. Soc., vol. 48, p. 198, 1892.—GUPPY, Proc. Zool. Soc. London, 1894, p. 650, pl. 41, fig. 13.

Ellipsoglandulina exponens A. SILVESTRI, Atti Pont. Accad. N. Lincei, vol. 54, pp. 103–109, 1901.—NUTTALL, Quart. Journ. Geol. Soc., vol. 84, p. 95, pl. 6, fig. 17, 1928.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 103, pl. 14, fig. 17, 1928.

The various specimens given may represent forms of a single species. Some of them are evidently megalospheric, while others represent the microspheric form.

Family ROTALIIDAE

Genus VALVULINERIA Cushman, 1926

VALVULINERIA ALLOMORPHINOIDES (Reuss)

PLATE 14, FIGURES 2a-c

Valvulina allomorphinoides REUSS, Sitz. Akad. Wiss. Wien, vol. 40, p. 223, pl. 11, figs. 6 a-c, 1860.

Discorbina allomorphinoides FRANKEL, Abh. geol. pal. Inst. Univ. Greifswald, vol. 6, p. 91, pl. 8, figs. 11 a, b, 1928; Abh. Preuss. Geol. Landes., vol. 111, p. 189, pl. 18, figs. 7 a, b, 1928.

Discorbis allomorphinoides CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 606, pl. 20, figs. 18, 19; pl. 21, fig. 5, 1926.

Test biconvex, slightly longer than broad, oval, periphery rounded; chambers distinct, on the dorsal side with the earlier whorls visible, ventrally involute, usually five in the last-formed whorl; sutures distinct, dorsally slightly curved, not depressed, ventrally slightly curved, slightly depressed; wall smooth; aperture narrow, below an overhanging flat, platelike lip.

The figured specimen, while somewhat more open in its coiling than is usual in this species, may possibly be included in its range of variation.

Genus GYROIDINA d'Orbigny, 1826

GYROIDINA DEPRESSA (Alth)

PLATE 14, FIGURES 1 a-c

Rotalia depressa ALTH, Haidinger's Naturw. Abh., vol. 3, p. 266, pl. 13, fig. 21, 1850.

Gyroidina depressa CUSHMAN and CHURCH, Proc. California Acad. Sci., ser. 4, vol. 18, p. 515, pl. 41, figs. 4-6, 1929.

Rotalia cretacea CARSEY, Univ. Texas Bull. 2612, p. 48, pl. 5, figs. 7 a, b, 1926.

Rotalia beccarii (LINNAEUS) var. *ripleyensis* W. BERRY, in Berry and Kelley, Proc. U. S. Nat. Mus., vol. 76, art. 19, p. 15, pl. 8, figs. 10-12, 1929.

Test much compressed, trochoid, biconvex, the dorsal side often nearly flat, periphery rounded, umbilicus often open; chambers numerous, 10 to 12 in the last-formed whorl, distinct; sutures distinct, on the dorsal side nearly flush with the surface, slightly limbate, curved, ventrally slightly curved, nearly radial, slightly depressed; wall smooth; aperture on the ventral side between the periphery and the umbilicus, low. Diameter, 0.25-0.45; height, 0.1-0.2 mm.

This is one of the common species of the Upper Cretaceous and is very widely distributed in Europe and America. It has had various names.

GYROIDINA NITIDA (Reuss)

PLATE 14, FIGURES 2a-c

Rotalina nitida REUSS, Geogn. Skizze Böhmen, vol. 2, pt. 1, p. 214, 1844;

Verstein. Böhm. Kreide, pt. 1, p. 35, pl. 8, fig. 52; pl. 12, figs. 8, 20, 1845-46.

Gyroidina sparksi WHITE, Journ. Pal., vol. 2, p. 297, pl. 40, fig. 8, 1928.

Our specimens may be referred to this somewhat variable species of Reuss. The figures show the general characters, but there are intermediate forms that tend toward the following species.

GYROIDINA GLOBOSA (v. Hagenow)

PLATE 14, FIGURES 3, 4

Nonionina globosa v. HAGENOW, Neues Jahrb. für Min., 1842, p. 574.

Rotalia globosa REUSS, Sitz. Akad. Wiss. Wien, vol. 44, pt. 1, p. 330, pl. 7, figs. 2 a, b, 1861 (1862).

Gyroidina naranjoensis WHITE, Journ. Pal., vol. 2, p. 296, pl. 40, fig. 5, 1928.

In its typical form this species has a very broadly rounded periphery, and the ventral side is deep. Intermediate forms seem to be present between this and the preceding species. The form is widely distributed in the Upper Cretaceous.

Genus EPONIDES Montfort, 1808

EPONIDES HAIDINGERII (d'Orbigny)

PLATE 14, FIGURES 5 a-c

Rotalina haidingerii D'ORBIGNY, Foram. Foss. Bass. Tert. Vienne, p. 154, pl. 8, figs. 7-9, 1846.

Test nearly circular in outline, in side view with a fairly high spire, dorsal side very convex, ventral side flattened or sometimes somewhat concave, periphery rounded; chambers in several whorls, about six or seven in the adult whorl, distinct, slightly inflated on the ventral side; sutures on the dorsal side slightly limbate, oblique, flush with the surface, on the ventral side slightly depressed, nearly radiate; wall smooth, distinctly perforate; aperture ventral between the umbilicus and the periphery, with a slight lip. Diameter, 0.5-0.8; height, 0.3-0.35 mm.

The Trinidad specimens are very close to d'Orbigny's species from the Vienna Basin and seem to be identical with it. Similar specimens occur in the Upper Cretaceous of the Gulf Coastal Plain of the United States.

Family CASSIDULINIDAE

Subfamily CERATOBULIMININAE

Genus PULVINULINELLA Cushman, 1926

PULVINULINELLA VELASCOENSIS (Cushman)

PLATE 14, FIGURES 6 a-c

Truncatulina velascoensis CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 1, pt. 1, p. 20, pl. 3, fig. 2, 1925; Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 606, pl. 21, fig. 8, 1926.

Rotalia velascoensis WHITE, Journ. Pal., vol. 2, p. 290, pl. 39, figs. 5 a-c, 1928.

Test nearly bilaterally symmetrical with a very thin, broad keel; chambers all visible from the dorsal side, only those in the last-formed coil from the ventral side, about 10 chambers in the last-formed coil, fewer in the earlier ones; chambers distinct, especially from the ventral side; sutures on the dorsal side raised and confluent, on the ventral side slightly depressed, curved; wall smooth on the ventral side, the dorsal side with an excavated area over each chamber; aperture elongate, narrow, on the ventral side of the last-formed chamber nearly in the axis of coiling. Diameter, up to 1.2; height, 0.4 mm.

This is a common species in the Velasco formation of Mexico and occurs in typical form in the Cretaceous of Trinidad. The position of the aperture places this species in the genus *Pulvinulinella*.

PULVINULINELLA ALATA (Marsson)

PLATE 15, FIGURES 1, 2

Discorbina alata MARSSON, Mitth. Nat. Ver. Neu-Vorpommern Rügen, vol. 10, p. 165, pl. 4, figs. 33 a-d, 1878.

Pulvinulina alata FRANKE, Abh. Preuss. Geol. Landes., vol. 111, p. 185, pl. 17, figs. 8 a-c, 1928.

Gyroidina florealis WHITE, Journ. Pal., vol. 2, p. 298, pl. 40, figs. 3 a-c, 1928.

Test plano-convex, the ventral side very strongly convex, dorsal side flattened or even slightly concave except in the center, which is slightly raised, periphery strongly keeled and developing a flat carina, which is often broken; chambers usually about six or seven in the last-formed whorl, distinct, inflated on the ventral side, but very slightly, if at all, on the dorsal side; sutures distinct, those of the ventral side sigmoidally curved and very slightly depressed, those of the dorsal side strongly oblique, distinctly limbate; wall smooth, but distinctly perforate; aperture ventral close to and parallel with the peripheral margin. Diameter, 0.9-1; height, 0.5 mm.

This species was originally described by Marsson from the Upper Cretaceous of the Island of Rügen. It has also been recorded from

the Cretaceous of Germany by Franke and is apparently the same as the species recorded by White from the Velasco shale of Mexico. The figured specimens from the Upper Cretaceous of Trinidad show well the general characters of the species.

Family CHILOSTOMELLIDAE

Subfamily ALLOMORPHININAE

Genus ALLOMORPHINA Reuss, 1850

ALLOMORPHINA TROCHOIDES (Reuss)

PLATE 15, FIGURES 3 a-c

Globigerina trochoides REUSS, Verstein. Böhm. Kreide, pt. 1, p. 36, pl. 12, fig. 22, 1845-46; Haidinger's Naturw. Abh., vol. 4, pt. 1, p. 37, pl. 3, fig. 5, 1851.

Valvulina trochoides FRANKE, Abh. Preuss. Geol. Landes., vol. 111, p. 162, pl. 15, figs. 2 a-c, 1928.

Test triserial, consisting of a conical early portion and an inflated later portion made up of the last three chambers in the adult; chambers of the early portion rather indistinct, last three greatly inflated and subglobular; sutures of the last portion distinct and depressed, early ones obscure; wall smooth; aperture an elongate slit at the base of the last-formed chamber. Length, 0.35; diameter, 0.3-0.35 mm.

This is a very peculiar little species, but it has a very wide distribution in the Upper Cretaceous of Europe and America. Reuss placed it as a *Globigerina*, but it evidently does not belong in that genus. Franke has placed it in *Valvulina*, but it seems to have a calcareous, perforate test. The triserial character of the test and the type of the aperture seem to show that this species should be placed as a primitive species of *Allomorphina* with a very high spire.

Subfamily ALLOMORPHINELLINAE

Genus PULLENIA Parker and Jones, 1862

PULLENIA QUINQUELOBA (Reuss)

PLATE 15, FIGURES 4 a, b

Nonionina quinqueloba REUSS, Zeitschr. deutsch. geol. Ges., vol. 3, p. 71, pl. 5, fig. 31, 1851.

Pullenia quinqueloba H. B. BRADY, Rep. Voy. Challenger, Zoology, vol. 9, p. 617, pl. 84, figs. 14, 15, 1884.—CUSHMAN and CHURCH, Proc. California Acad. Sci., ser. 4, vol. 18, p. 517, pl. 41, figs. 10, 11, 1929.

Test planispiral in the adult, completely involute, compressed, periphery rounded; chambers typically five in the last-formed coil, increasing gradually in size as added, only slightly inflated; sutures

distinct, very slightly depressed, radial; wall smooth; aperture at the base of the apertural face of the chamber, either an elongate slit or a somewhat constricted opening with a slight lip. Diameter, 0.35–0.45; thickness, 0.2–0.25 mm.

This species has been recorded from Cretaceous to Recent, and there may be more than one species in the series, although there is some variation in all the series studied. The figured specimen shows well the common Cretaceous form, which is widely distributed in Europe and America.

PULLENIA CORYELLI White

PLATE 15, FIGURES 5 *a*, *b*

Pullenia sphaeroides CUSHMAN (not d'Orbigny), Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 605, pl. 21, figs. 2 *a*, *b*, 1926.

Pullenia coryelli WHITE, Journ. Pal., vol. 3, p. 56, pl. 5, fig. 22, 1929.

Test subspherical, periphery very broadly rounded, slightly umbilicate; chambers distinct but not inflated, six or seven in the final coil; sutures distinct, very slightly if at all depressed; wall smooth; aperture an elongate curved slit, at the base of the apertural face. Diameter, up to 0.5 mm.

This seems to be a widely distributed form in the American Cretaceous, it being recorded from the Velasco shale of Mexico and also occurring in Trinidad.

Family GLOBIGERINIDAE

Subfamily GLOBIGERININAE

Genus GLOBIGERINELLA Cushman, 1927

GLOBIGERINELLA sp. (?)

PLATE 15, FIGURES 6 *a*, *b*

Rare specimens of this genus occur in the Trinidad Cretaceous, but specimens are not in sufficient numbers and completeness to give full characters for specific determination.

Family GLOBOROTALIIDAE

Genus GLOBOTRUNCANA Cushman, 1927

GLOBOTRUNCANA ARCA (Cushman)

PLATE 15, FIGURES 7 *a*–*c*

Pulvinulina arca CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 2, p. 23, pl. 3, figs. 1 *a*–*c*, 1926.

Globotruncana arca CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 3, p. 91, pl. 19, fig. 11, 1927; Journ. Pal., vol. 1, p. 169, pl. 28, fig. 28, 1927.—MOREMAN, Journ. Pal., vol. 1, p. 100, pl. 16, figs. 16, 17, 1927.—CUSHMAN and CHURCH, Proc. California Acad. Sci., ser. 4, vol. 8, p. 518, pl. 41, figs. 1–3, 1929.

Globigerina rosetta CARSEY, Univ. Texas Bull. 2612, p. 44, pl. 5, figs. 3 *a*–*c*, 1926.

This is one of the common species of the Upper Cretaceous of Mexico, Trinidad, and the Gulf Coastal Plain of the United States.

GLOBOROTALIA VELASCOENSIS (Cushman)

PLATE 15, FIGURES 8 a-c

Pulvinulina velascoensis CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 1, pt. 1, p. 19, pl. 3, figs. 5 a-c, 1925.

Globorotalia velascoensis CUSHMAN, Journ. Pal., vol. 1, pt. 2, p. 169, pl. 27, figs. 7-9, 1927.—WHITE, Journ. Pal., vol. 2, p. 281, pl. 38, figs. 2 a-c, 1928.

This is a somewhat variable species with a fairly long range in the Velasco shale of Mexico. There is a considerable variation in the degree of the projection about the umbilical region of the ventral side and the convexity of the dorsal surface and the amount of projection of the periphery. The figured specimen is from the Cretaceous of Lizard Springs.

Family ANOMALINIDAE

Subfamily ANOMALININAE

Genus ANOMALINA d'Orbigny, 1826

ANOMALINA AMMONOIDES (Reuss)

PLATE 16, FIGURES 1 a-c

Rosalina ammonoides REUSS, Geogn. Skizze Böhmen, vol. 2, pt. 1, p. 214, 1844; Verstein. Böhm. Kreide, pt. 1, p. 36, pl. 8, fig. 53, pl. 13, fig. 66, 1845-46; Haidinger's Naturw. Abh., vol. 4, pt. 1, p. 36, pl. 3, fig. 2, 1851.

The early references to this species are given above. Originally described from the Cretaceous of Europe, it has been used by many authors to include a wide variety of forms from Cretaceous to Recent, many of which have little in common with the types. The accompanying figures illustrate a Trinidad species, which seems very close to Reuss's species and to which we are applying his name.

ANOMALINA POLYRRAPHES (Reuss)

PLATE 16, FIGURES 2 a-c

Rotalina polyrraphes REUSS, Verstein. Böhm. Kreide, pt. 1, p. 35, pl. 12, fig. 18, 1845-46; Haidinger's Naturw. Abh., vol. 4, pt. 1, p. 35, pl. 3, fig. 1, 1851.
Cibicides risseri WHITE, Journ. Pal., vol. 2, p. 298, pl. 40, figs. 10 a-c, 1928.

The figures represent a species from Trinidad that also occurs in the Velasco shale of Mexico and in the Gulf Coastal Plain region of the United States. It seems to be identical with the species described by Reuss from the Cretaceous of Europe. There is a slight tendency toward becoming evolute, but this is apparently never carried to the point where the species can be placed in the genus *Planulina*. Our

figured specimen is slightly irregular in the last three chambers, but usually these are very uniform in size and shape, the periphery broadly rounded and the sutures distinct and somewhat limbate.

ANOMALINA RUBIGINOSA Cushman

PLATE 16, FIGURES 3-5

Anomalina rubiginosa CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 607, pl. 21, figs. 6 a-c, 1926.

Planulina rubiginosa WHITE, Journ. Pal., vol 2, p. 303, pl. 41, figs. 6 a-c, 1928.

Test close coiled, the dorsal side slightly convex, ventral side somewhat concave, periphery broadly rounded, 9 or 10 chambers in the last-formed coil, rather indistinct, as are also the sutures, more distinct in the last few chambers, dorsal side with the wall very coarsely punctate, ventral side, especially in the earlier portion, with very large depressed areas of an irregular form, giving a peculiar appearance to that portion of the test; aperture along the ventral margin of the last-formed chamber. Diameter, 0.5-0.8; height, 0.3-0.4 mm.

This is a common and well-marked species in the Velasco shale of Mexico and occurs in typical form in the Trinidad material. Some of the young stages are also shown here. So far as our material from both areas shows the species does not become sufficiently evolute to warrant placing it in the genus *Planulina*.

Genus PLANULINA d'Orbigny, 1826

PLANULINA CONSTRICTA (v. Hagenow)

PLATE 16, FIGURES 6 a-c

Rotalia constricta v. HAGENOW, Neues Jahrb. für Min., 1842, p. 571.—REUSS, Sitz. Akad. Wiss. Wien, vol. 44, pt. 1, p. 329, pl. 6, fig. 7, 1861 (1862).

The accompanying figures are of a specimen typical of a Trinidad species that seems identical with that of von Hagenow as figured by Reuss. It is much compressed, has numerous chambers, and in the adult becomes somewhat evolute on both sides. The dorsal side has a thickened umbonal region with a thickened ring about it outside a deep groove.

Similar forms occur widely distributed in the American Cretaceous. It rather remotely resembles *Planulina taylorensis* (Carsey), but that is a more evolute form and keeled, with numerous differences.

PLANULINA SCHLOENBACHI (Reuss)

PLATE 16, FIGURES 7 a-c

Rotalia schloenbachi REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, p. 84, pl. 10, figs. 5 a-c, 1862 (1863).

Test much compressed, evolute, periphery subacute, both sides somewhat umbonate; chambers distinct, numerous, of uniform shape,

gradually increasing in size as added; sutures distinct, curved, limbate, and raised; wall of the chambers smooth, coarsely perforate, umbo very coarsely pitted; aperture peripheral and extending over onto the dorsal side. Length, 0.8; breadth, 0.7; thickness, 0.3 mm.

This species with its strongly raised sutures and coarsely pitted umbos seems to be identical with that described by Reuss from the Cretaceous of Europe in the reference given above. It is a very distinctive form.

PLANULINA sp. (?)

PLATE 16, FIGURES 8 a-c

The specimen figured seems to have characters in common with that described by Reuss¹³ from Europe as "*Rotalia involuta*," and with "*Rotalia mortoni*"¹⁴ from the Cretaceous of New Jersey, but more material is needed for determining the full characters of this form.

¹³ Sitz. Akad. Wiss. Wien, vol. 44, pt. 1, p. 313, pl. 2, figs. 4 a, b, 1861 (1862).

¹⁴ Idem, p. 337, pl. 8, figs. 1 a-c.

EXPLANATION OF PLATES

PLATE 1

FIGURES 1, 2. *Rhabdammina discreta* H. B. Brady, $\times 40$.

3. *Saccammina rhumbleri* (Franke) (?), $\times 40$.

4-6. *Pelosina complanata* Franke, $\times 35$. Figures 4 and 6, composed largely of cement and with smooth surface. Figure 5, specimen with a roughened surface of angular fragments.

7, 8. *Hyperammina elongata* H. B. Brady, $\times 40$.

9. *Hyperammina* (?) sp. (?), $\times 35$.

10-12. *Saccorhiza ramosa* (H. B. Brady), $\times 35$. Broken fragments showing characteristic curvature of the test and roughened surface.

13. *Reophaea* sp. (?), $\times 40$.

14. *Hormosina globulifera* H. B. Brady, $\times 35$.

15-17. *Nodellum velascoensis* (Cushman), $\times 40$. Figures 15, 16, much distorted. Figure 17, more normal form. Figures 15, 17, megalospheric. Figure 16, microspheric.

PLATE 2

FIGURE 1. *Ammodiscus glabratus* Cushman and Jarvis, $\times 35$.

2, 3. *Ammodiscus pennyi* Cushman and Jarvis, $\times 35$. Figure 2, side view of megalospheric form. Figure 3, vertical section of another specimen.

4, 5. *Ammodiscoides turbinatus* Cushman, $\times 30$. Figure 4, adult specimen from dorsal side. Figures 5 *a*, *b*, young specimen: *a*, Dorsal side; *b*, ventral side, showing the conical stage in the young.

6, 7. *Glomospira gordialis* (Jones and Parker), $\times 40$.

8-10. *Glomospira charoides* (Jones and Parker) var. *corona* Cushman and Jarvis, $\times 60$.

11 *a*, *b*. *Lituotuba lituiformis* (H. B. Brady), $\times 35$. *a*, *b*, opposite sides.

12. *Ammolagena clavata* (Jones and Parker), $\times 30$. Megalospheric specimen attached to *Ammodiscus pennyi*.

13-15. *Haplophragmoides coronata* (H. B. Brady), $\times 30$. Specimens more or less distorted, showing the peculiar forms assumed by this species.

PLATE 3

FIGURE 1. *Haplophragmoides excavata* Cushman and Waters, $\times 80$.

2 *a*, *b*. *Haplophragmoides eggeri* Cushman, $\times 30$. *a*, Side view; *b*, peripheral view.

3. *Oribrostomoides trinitatensis* Cushman and Jarvis, $\times 60$. Apertural view of holotype specimen.

4, 5. *Ammobaculites coprolithiforme* (Schwager), $\times 40$. Side views of specimens showing different stages in development.

6 *a*, *b*. *Cyclammina elegans*, new species, $\times 25$. *a*, Side view; *b*, peripheral view.

7 *a*, *b*. *Spiroplectammina dentata* (Alth), $\times 30$. *a*, Front view; *b*, apertural view.

FIGURES 8, *a*, *b*. *Spiroplectammina anceps* (Reuss) var., $\times 40$. *a*, Front view; *b*, apertural view.

9, 10. *Spiroplectammina excolata* (Cushman). Figure 9, $\times 60$; front view of partially developed specimen. Figure 10, $\times 40$; very highly developed specimen. *a*, Front view; *b*, apertural view.

PLATE 4

FIGURES 1, 2. *Textularia concinna* Reuss. Figure 1, $\times 40$. Figures 2 *a*, *b*, $\times 30$. *a*, Front view; *b*, apertural view.

3 *a*, *b*. *Verneuilina polystropha* (Reuss), $\times 60$. *a*, Front view; *b*, apertural view.

4 *a*, *b*. *Tritaxia pyramidata* Reuss, $\times 25$. *a*, Front view; *b*, apertural view.

5. *Gaudryina filiformis* Berthelin, $\times 80$.

6 *a*, *b*. *Gaudryina rugosa* d'Orbigny, $\times 30$. *a*, Front view; *b*, apertural view.

7-10. *Gaudryina retusa* Cushman, $\times 40$. Figure 8 *a*, Front view; *b*, apertural view. Figure 10, early Verneuiline stage.

11. *Gaudryina indentata* Cushman and Jarvis, $\times 35$. Holotype.

PLATE 5

FIGURES 1, 2. *Gaudryina oxycona* Reuss. Figure 1, $\times 40$. Figure 2, $\times 35$. *a*, *a*, Front views; *b*, *b*, apertural views.

3. *Gaudryina laevigata* Franke var. *pyramidata* Cushman, $\times 35$.

4. *Clavulina aspera* Cushman, $\times 30$.

5. *Clavulina trilatera* Cushman, $\times 30$.

6-8. *Clavulina aspera* Cushman, *whitei*, new variety, $\times 30$. Figure 6, holotype; *a*, side view; *b*, apertural view. Figures 7, 8, microspheric specimens with angular later portions; *a*, *a*, side views; *b*, *b*, apertural views.

9-11. *Clavulina chitinoso*, new species, $\times 40$. Figure 9, holotype. All specimens somewhat distorted by pressure.

PLATE 6

FIGURES 1 *a*, *b*. *Rzehakina epigona* (Rzehak) var. *lata* Cushman and Jarvis, $\times 30$. *a*, Side view; *b*, apertural view.

2-5. *Trochammina globigeriniformis* (Parker and Jones), $\times 30$. Figure 2 *a*, dorsal view; *b*, side view. Figure 3, side view. Figure 4, ventral view of a much distorted and compressed specimen. Figure 5, dorsal view.

6 *a-c*. *Trochammina trinitatis* Cushman and Jarvis, $\times 40$. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.

7 *a*, *b*. *Robulus williamsoni* (Reuss), $\times 40$. *a*, Side view; *b*, apertural view.

8, 9. *Robulus oligostegia* (Reuss), $\times 40$. Figure 9 *a*, side view; *b*, apertural view.

10 *a*, *b*. *Robulus trinitatis*, new species, $\times 55$. *a*, Side view; *b*, apertural view.

11 *a*, *b*. *Robulus sternalis* (Berthelin), $\times 40$. *a*, Side view; *b*, apertural view.

PLATE 7

- FIGURES 1, 2. *Robulus subalatus* (Reuss), $\times 35$. Figure 2 *a*, side view; *b*, apertural view.
- 3 *a*, *b*. *Robulus macrodiscus* (Reuss), $\times 40$. *a*, Side view; *b*, apertural view.
- 4 *a*, *b*. *Robulus discrepans* (Reuss), $\times 40$. *a*, Side view; *b*, apertural view.
- 5 *a*, *b*. *Lenticulina navicula* (d'Orbigny), $\times 40$. *a*, Side view; *b*, apertural view.
- 6 *a*, *b*. *Lenticulina nuda* (Reuss), $\times 60$. *a*, Side view; *b*, apertural view.
- 7 *a*, *b*. *Marginulina grata* (Reuss), $\times 60$. *a*, Side view; *b*, peripheral view.

PLATE 8

- FIGURES 1, 2. *Planularia advena*, new species, $\times 15$. Figure 1, holotype; *a*, side view; *b*, apertural view.
- 3 *a*, *b*. *Marginulina grata* (Reuss), $\times 40$. *a*, Side view; *b*, peripheral view.
- 4 *a*, *b*. *Marginulina multiscriptata* (Reuss), $\times 40$. *a*, Side view; *b*, peripheral view.
- 5 *a*, *b*. *Marginulina schloenbachi* (Reuss), $\times 40$. *a*, Side view; *b*, peripheral view.
- 6 *a*, *b*. *Marginulina modesta* Reuss, $\times 25$. *a*, Side view; *b*, peripheral view.
- 7, 8. *Marginulina bullata* Reuss. Figure 7, $\times 40$. Figure 8, $\times 60$. Figure 7 *a*, side view; *b*, apertural view.
9. *Marginulina humilis* (Reuss), $\times 30$.

PLATE 9

- FIGURES 1 *a*, *b*. *Marginulina joncsi* Reuss, $\times 40$. *a*, Side view; *b*, peripheral view.
- 2 *a*, *b*. *Marginulina decorata* (Reuss), $\times 25$. *a*, Side view; *b*, peripheral view.
- 3, 4. *Marginulina trilobata* d'Orbigny. Figure 3, $\times 25$. Figure 4, $\times 20$. Figure 3 *a*, side view; *b*, peripheral view. Figure 4 *a*, side view; *b*, peripheral view.
5. *Dentalina megapolitana* Reuss, $\times 20$.
- 6, 7. *Dentalina filiformis* Reuss (?), $\times 20$. Figure 6, later chambers. Figure 7, earlier chambers including the proloculum.
- 8 *a*, *b*. *Dentalina catenula* Reuss, $\times 60$. *a*, Side view; *b*, apertural view.
9. *Dentalina legumen* (Reuss), $\times 40$.
- 10-12. *Dentalina confluens* Reuss, $\times 20$.
13. *Dentalina* sp.(?), $\times 20$.

PLATE 10

- FIGURE 1. *Dentalina annulata* (Reuss), $\times 60$.
2. *Dentalina lorneiiana* d'Orbigny, $\times 30$.
3. *Dentalina* sp.(?), $\times 25$.
4. *Nodosaria concinna* Reuss, $\times 40$.

FIGURE 5. *Nodosaria limbata* d'Orbigny, $\times 60$.

6 a, b. *Nodosaria limbata* d'Orbigny *tumidata*, new variety, $\times 20$. a, Side view; b, apertural view.

7, 8. *Nodosaria limbata* d'Orbigny *basiorinata*, new variety, $\times 20$. Figure 8, holotype.

9. *Nodosaria monile* v. Hagenow, $\times 20$.

10. *Nodosaria orthopleura* Reuss, $\times 20$.

11. *Nodosaria brevitesta* Franke, $\times 60$.

12. *Nodosaria* cf. *marcki* Reuss, $\times 60$.

13. *Nodosaria affinis* Reuss, $\times 20$.

14, 15. *Nodosaria paupercula* Reuss, $\times 20$.

PLATE 11

FIGURES 1-4. *Nodosaria velascoensis* Cushman. Figures 1, 2, $\times 60$. Figures 3, 4, $\times 30$. Figures 1, 2, portions possibly of the same specimen.

5. *Nodosaria aspera* Reuss, $\times 30$.

6. *Nodosaria* sp. (?), $\times 20$.

7, 8. *Pseudoglandulina cylindracea* (Reuss). Figure 7, $\times 30$. Figure 8, $\times 20$.

9. *Pseudoglandulina parallela* (Marsson), $\times 40$.

10-12. *Pseudoglandulina bistegia* (Olszewski) (?). Figures 10, 11, $\times 25$.

Figure 12, $\times 40$. Figure 10 a, side view; b, apertural view.

Figures 10 and 11 are of a peculiar form in which the proloculum is peculiarly rugose.

13. *Pseudoglandulina* sp. (?), $\times 40$.

14. *Flabellina semireticulata* Cushman and Jarvis, $\times 50$.

15. *Flabellina reticulata* Reuss, $\times 50$.

PLATE 12

FIGURE 1. *Flabellina interpunctata* von der Marck, $\times 40$.

2. *Flabellina elliptica* (Nilsson), $\times 15$.

3. *Fronidicularia elongata* White (?), $\times 40$.

4. *Fronidicularia cordai* Reuss, $\times 30$. Apertural half of a broken specimen.

5. *Fronidicularia gracilis* Franke (?), $\times 20$. Apertural half of a broken specimen.

6. *Lagena orbignyana* (Seguenza), $\times 40$.

7 a, b. *Lagena orbignyana* (Seguenza) var., $\times 40$. a, Side view; b, apertural view.

8 a, b. *Guttulina adhaerens* (Olszewski), $\times 40$. a, Side view, b, apertural view.

9 a, b. *Pseudopolymorphina ozawana*, new species, $\times 20$. a, Front view; b, apertural view.

10, 11. *Ramulina* sp. (?), $\times 30$

12 a, b. *Nonion cretaceum*, new species, $\times 40$. a, Side view; b, peripheral view.

13 a, b. *Operculina catenula*, new species, $\times 25$. a, Side view; b, peripheral view.

PLATE 13

FIGURES 1 *a, b. Gümbelina* sp. (?), $\times 40$. *a*, Front view; *b*, side view.

2. *Bolivinoidea decorata* (Jones) var. *delicatula* Cushman, $\times 75$.

3 *a, b. Bolivinoidea trinitatensis* Cushman and Jarvis, $\times 75$. *a*, Front view; *b*, apertural view.

4 *a, b. Bulimina trinitatensis* Cushman and Jarvis, $\times 75$. *a*, Front view; *b*, apertural view.

5, 6. *Spiroplectoides clotho* (Grzybowski), $\times 75$. Figure 5, microspheric form. Figure 6, megalospheric form.

7. *Loxostomum platium* (Carsey), $\times 55$.

8 *a, b. Pleurostomella clavata* Cushman, $\times 40$. *a*, Front view; *b*, apertural view.

9, 10. *Ellipsopleurostomella curta* Cushman, $\times 40$. Figure 10 *a*, side view; *b*, apertural view.

11-13. *Ellipsinodosaria subnodosa* (Guppy). Figure 11, $\times 20$. Figures 12, 13, $\times 40$. Figures 11, 13, microspheric forms. Figure 12, megalospheric form.

14-16. *Ellipsoglandulina exponens* (H. B. Brady), $\times 50$. *a, a*, Side views; *b, b*, apertural views.

17 *a-c. Valvulineria allomorphinoides* (Reuss), $\times 40$. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.

PLATE 14

FIGURES 1 *a-c. Gyroidina depressa* (Alth), $\times 55$. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.

2 *a-c. Gyroidina nitida* (Reuss), $\times 40$. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.

3, 4. *Gyroidina globosa* (v. Hagenow). Figure 3, $\times 55$. Figure 4, $\times 40$. *a, a*, Dorsal views; *b, b*, ventral views; *c, c*, peripheral views.

5 *a-c. Eponides haidingerii* (d'Orbigny), $\times 40$. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.

6 *a-c. Pulvinulinella velascoensis* (Cushman), $\times 40$. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.

PLATE 15

FIGURES 1, 2. *Pulvinulinella alata* (Marsson), $\times 40$. Figure 1 *a*, dorsal view; *b*, ventral view; *c*, peripheral view.

3 *a-c. Allomorphina trochoides* (Reuss), $\times 75$. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.

4 *a, b. Pullenia quinqueloba* (Reuss), $\times 40$. *a*, Side view; *b*, apertural view.

5 *a, b. Pullenia coryelli* White, $\times 40$. *a*, Side view; *b*, apertural view.

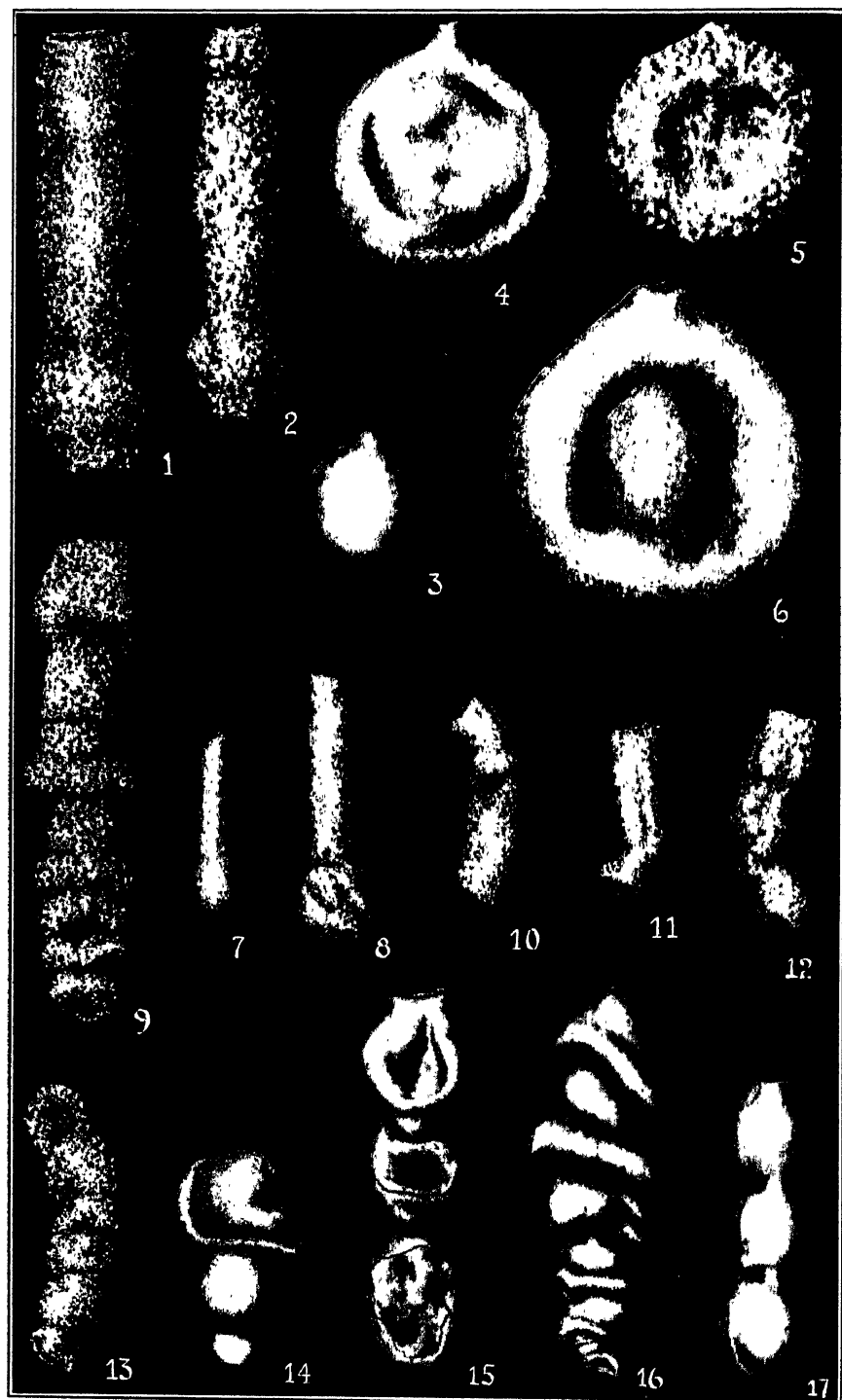
6 *a, b. Globigerinella* sp. (?), $\times 55$. *a*, Side view; *b*, apertural view.

7 *a-c. Globotruncana arca* (Cushman), $\times 40$. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.

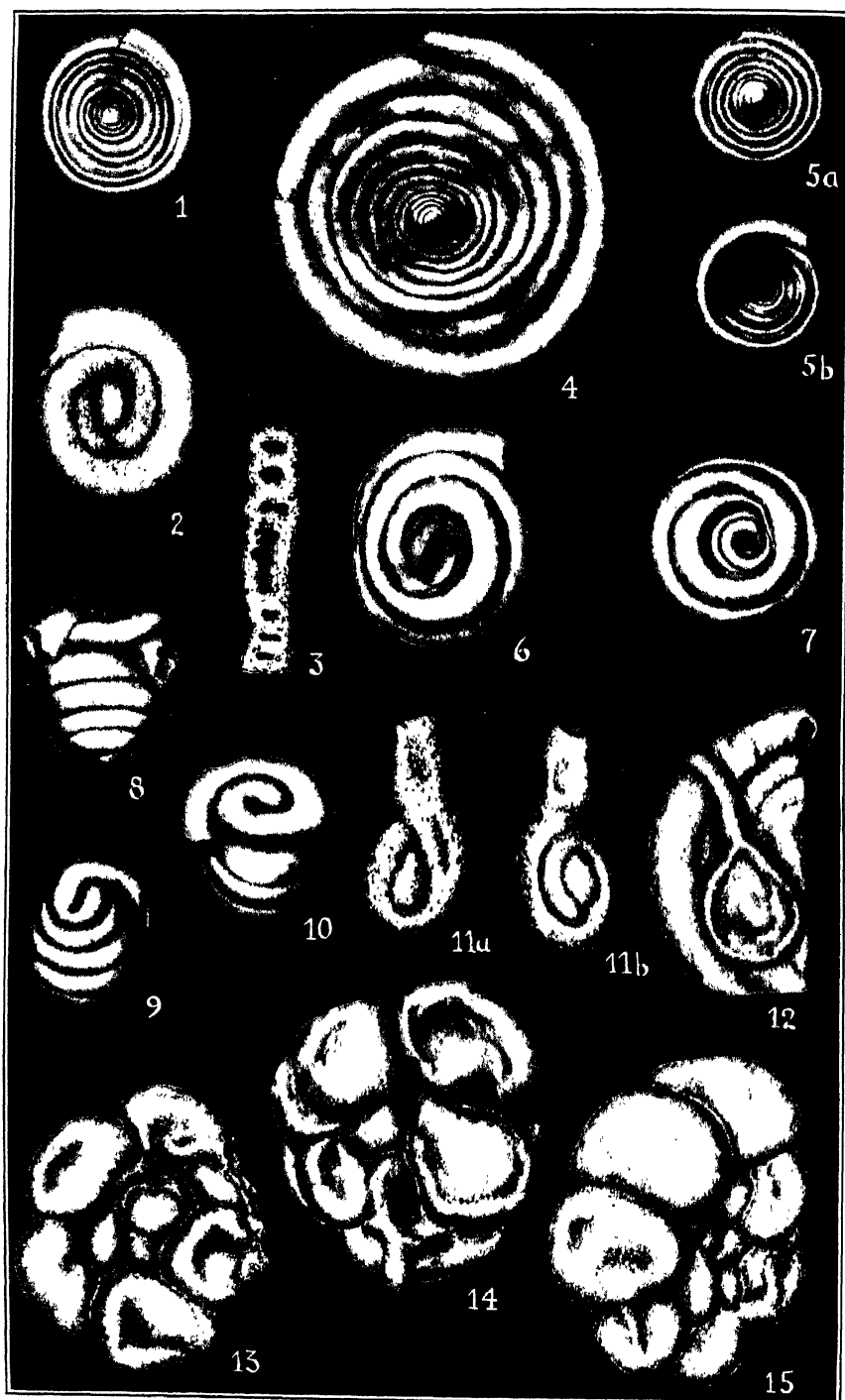
8 *a-c. Globorotalia velascoensis* (Cushman), $\times 70$. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.

PLATE 16

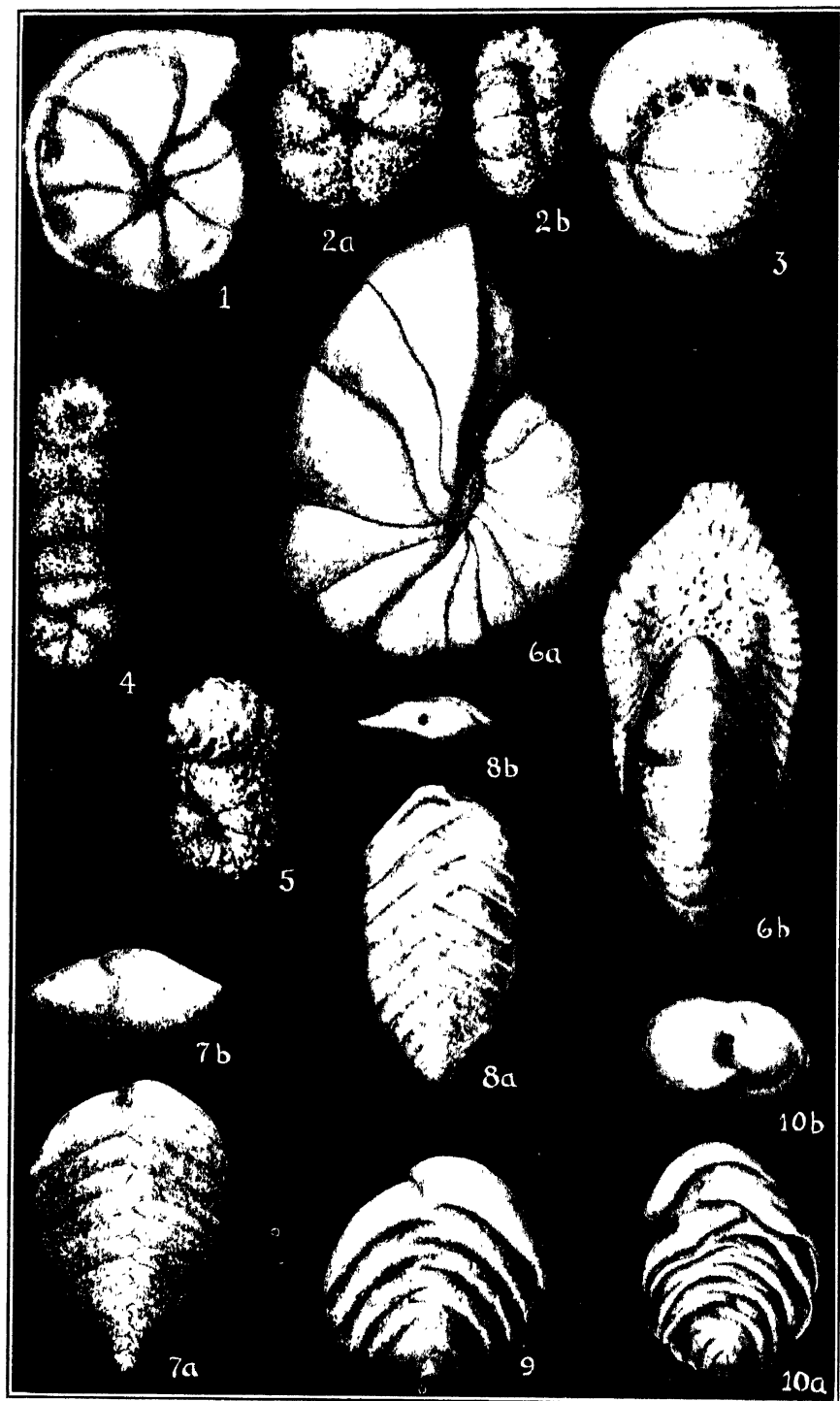
- FIGURES 1 *a-c. Anomalina ammonoides* (Reuss), $\times 40$. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.
- 2 *a-c. Anomalina polyrraphes* (Reuss), $\times 40$. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.
- 3-5. *Anomalina rubiginosa* Cushman, $\times 40$. Figures 3, 4, young stages showing variation. Figure 5, adult. *a, a, a*, Dorsal views; *b, b, b*, ventral views; *c, c, c*, peripheral views.
- 6 *a-c. Planulina constricta* (v. Hagenow), $\times 40$. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.
- 7 *a-c. Planulina schloenbachi* (Reuss), $\times 40$. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.
- 8 *a-c. Planulina* sp. (?), $\times 40$. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.



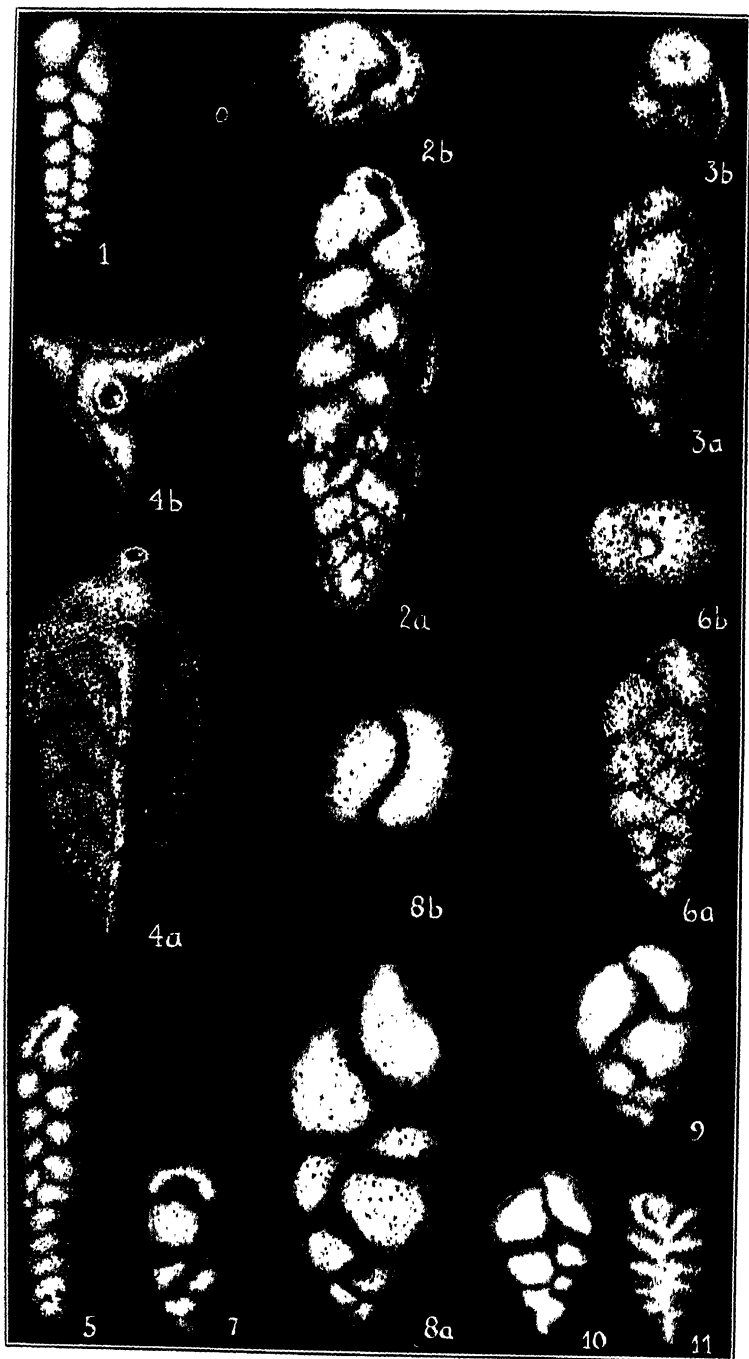
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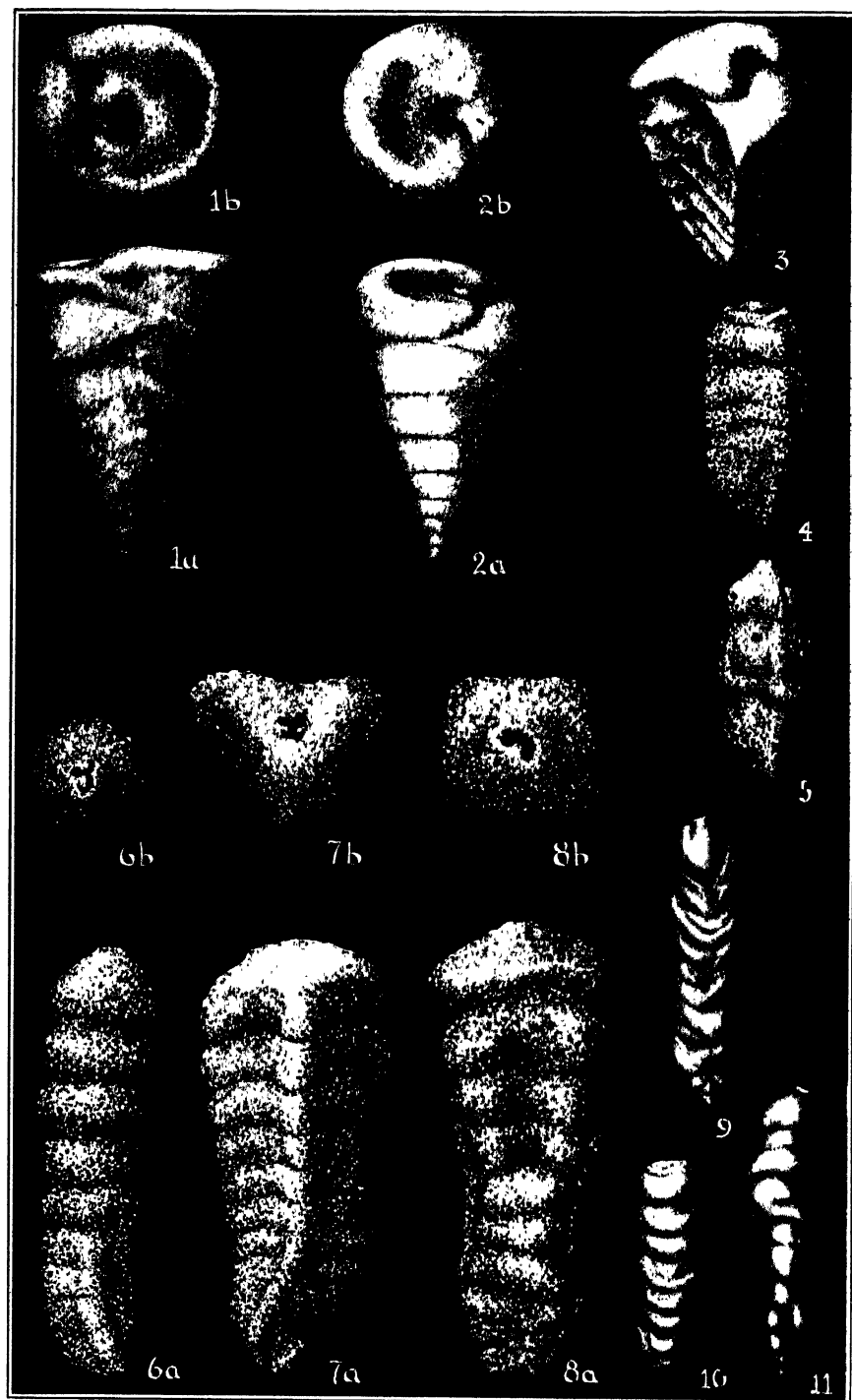


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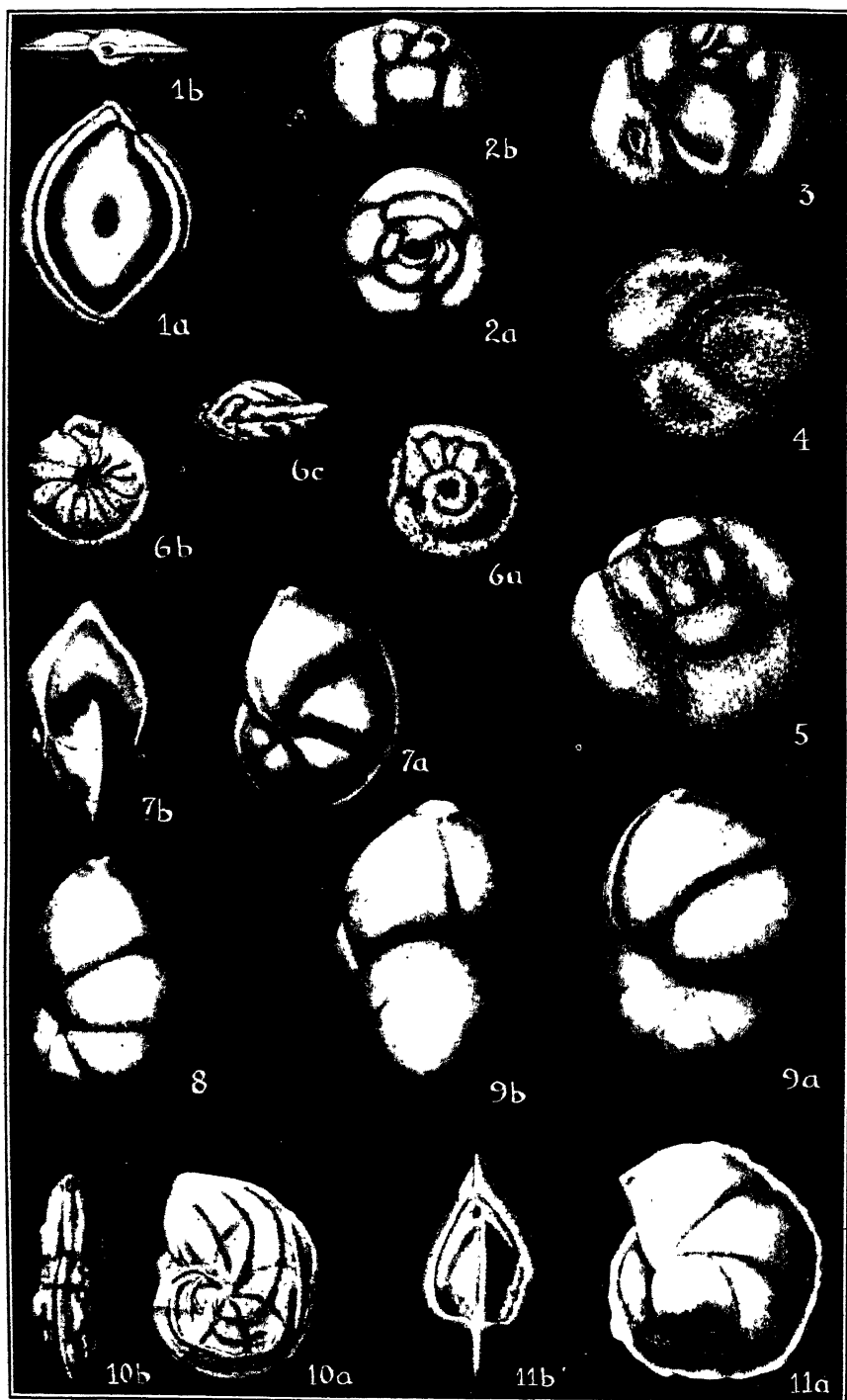
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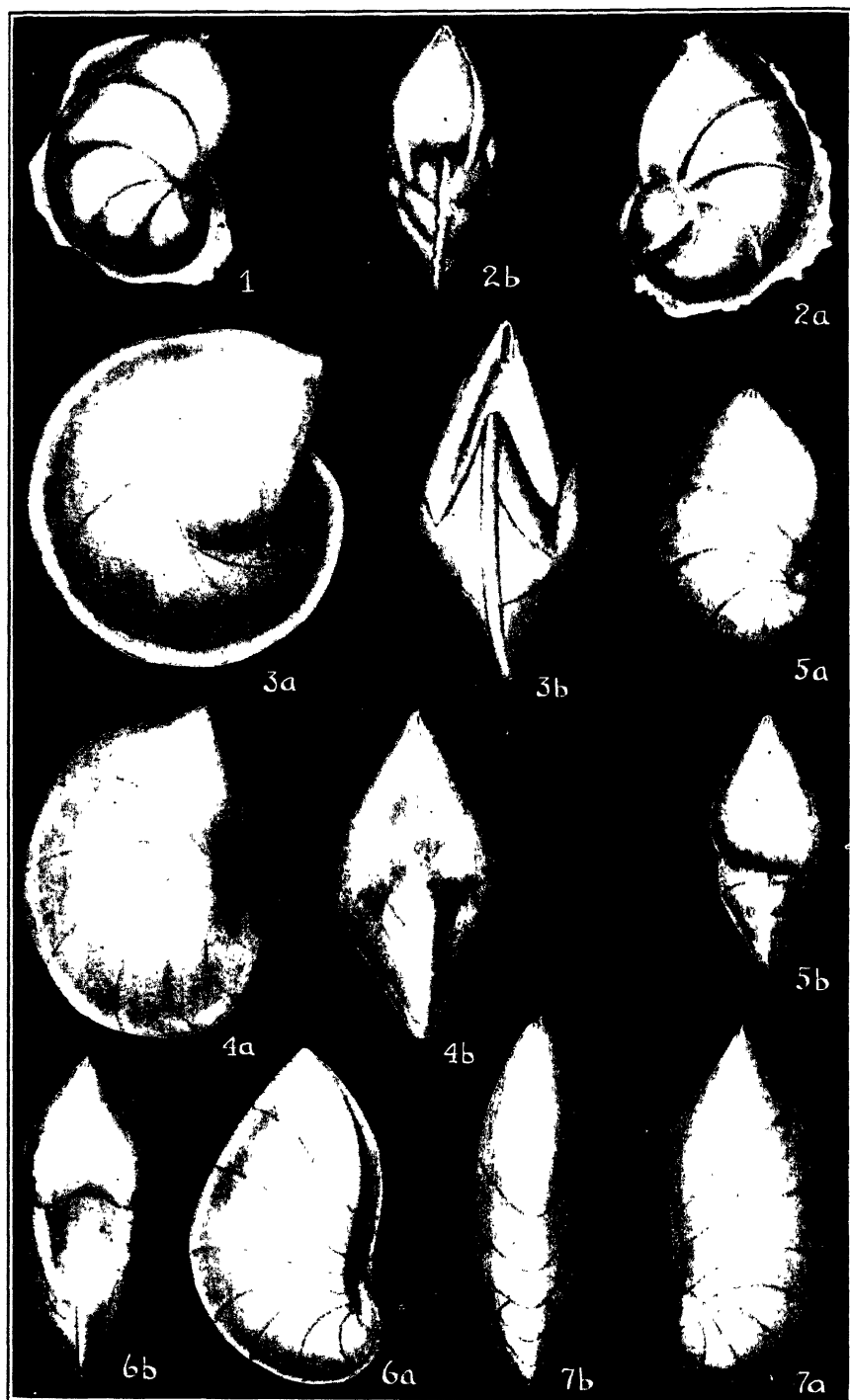
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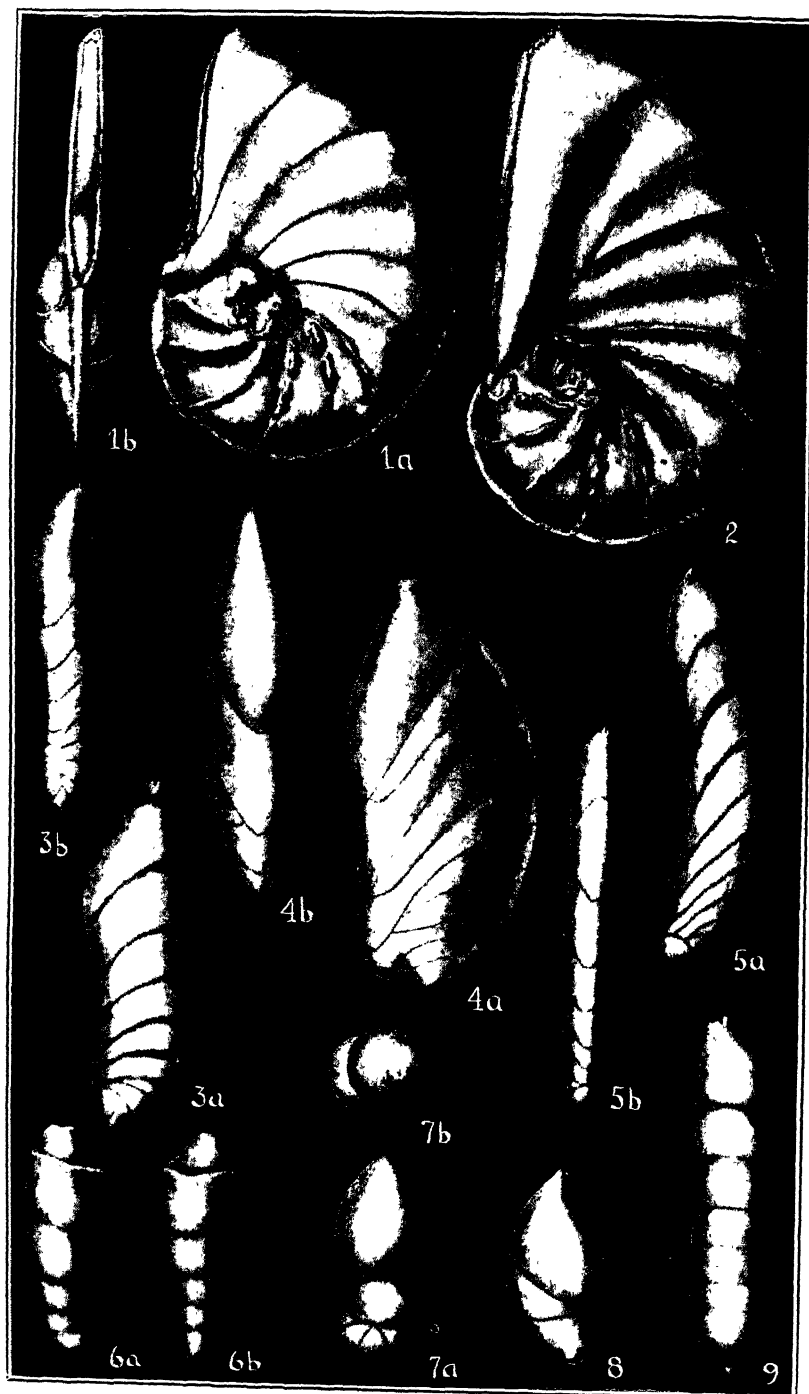
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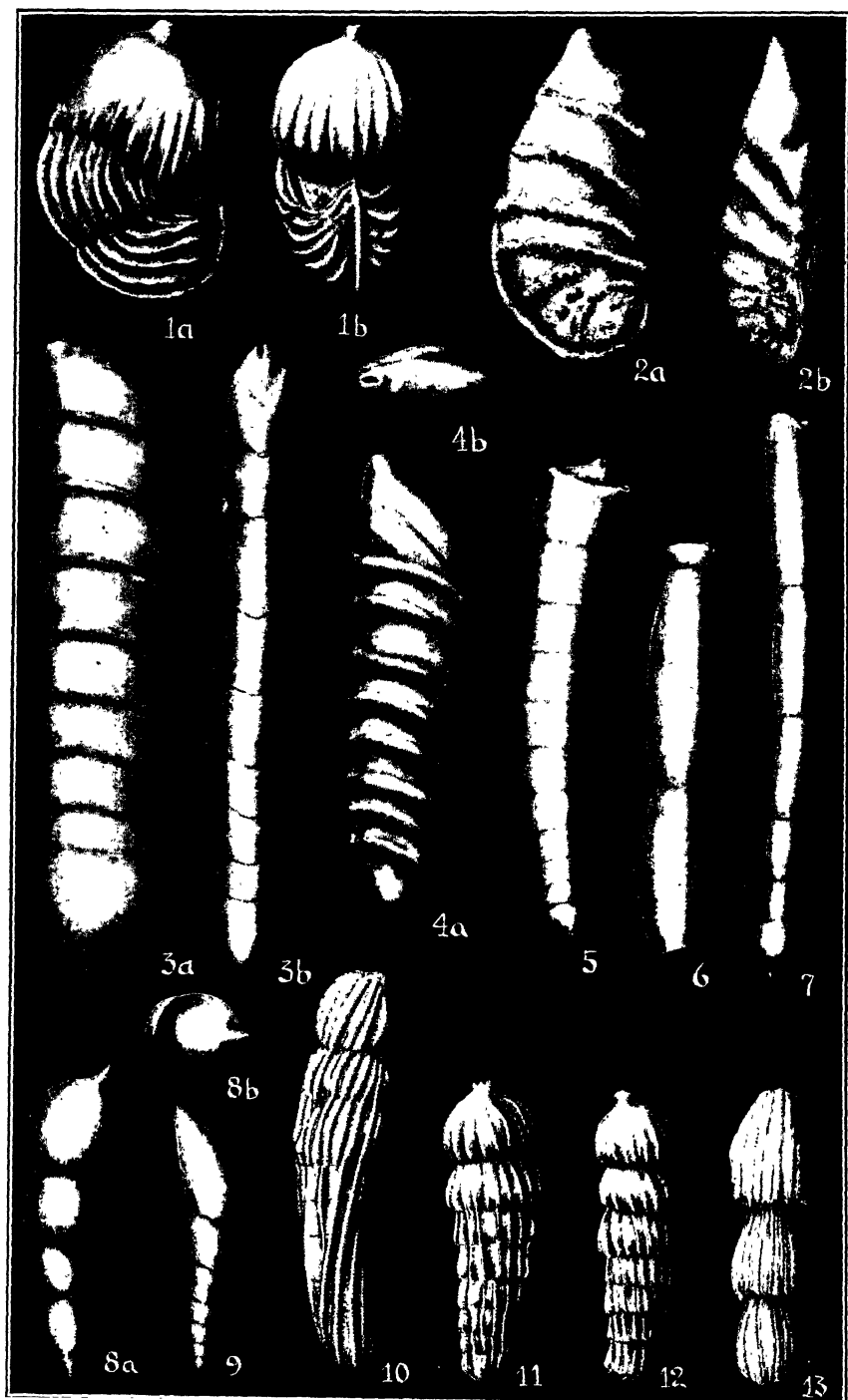
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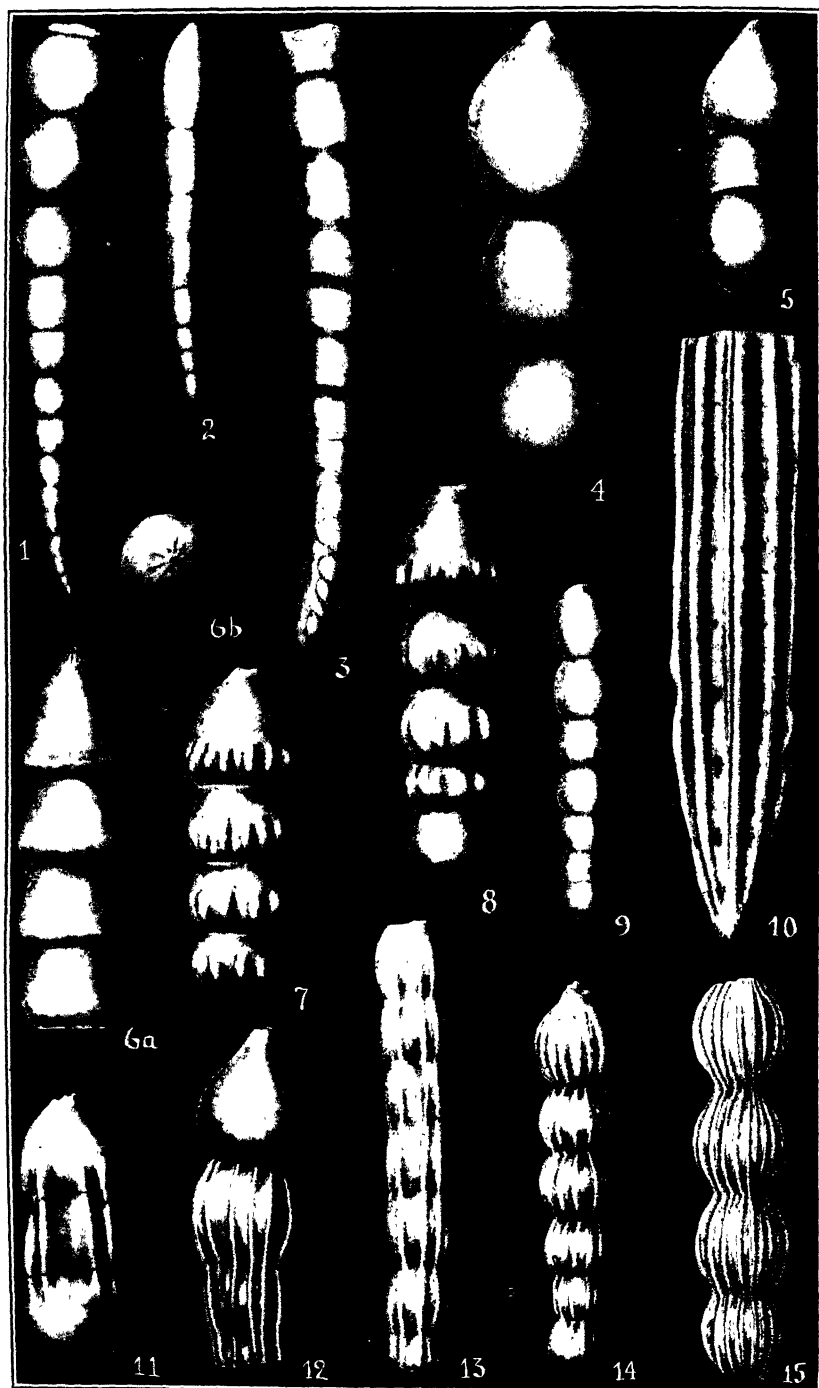
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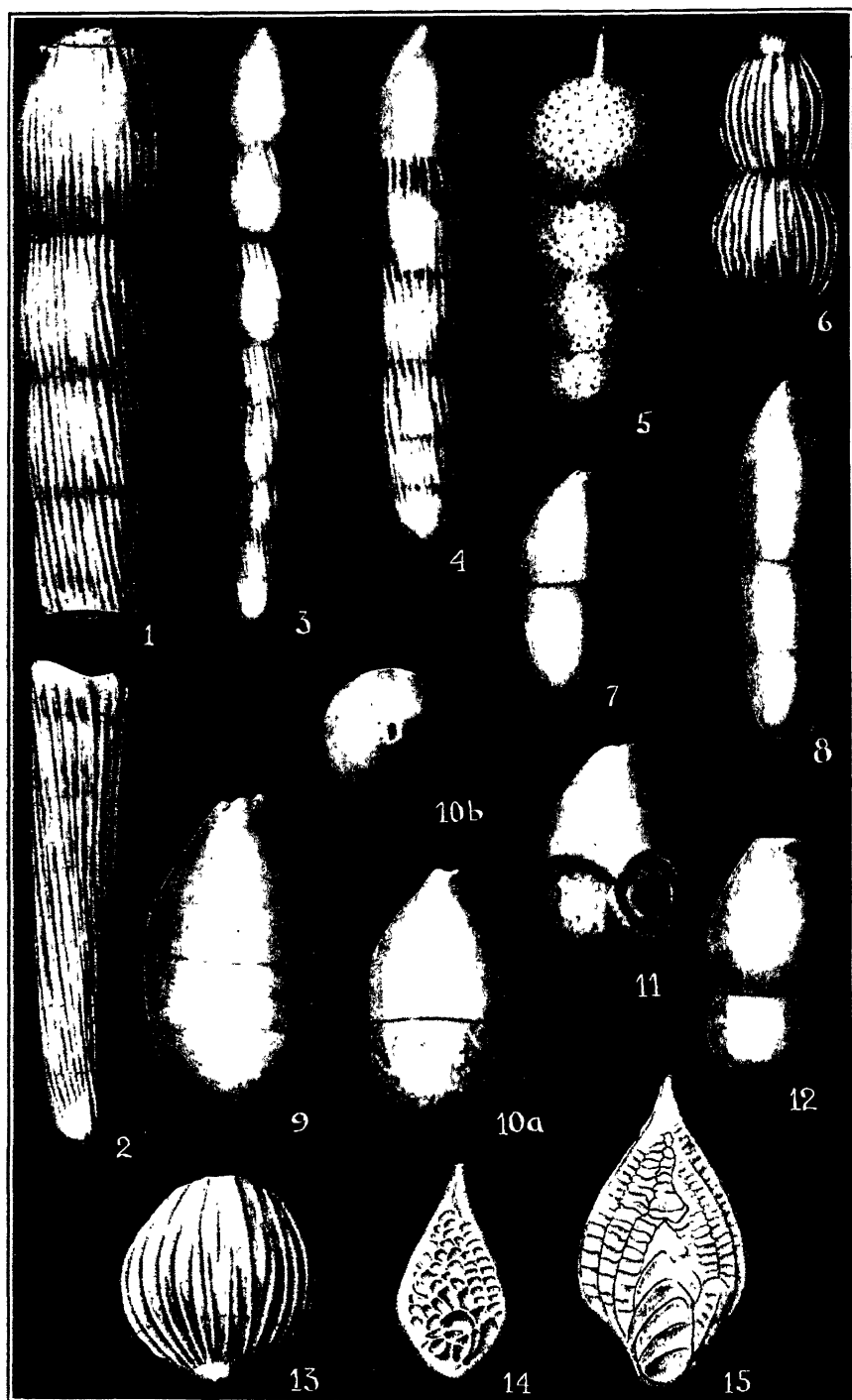
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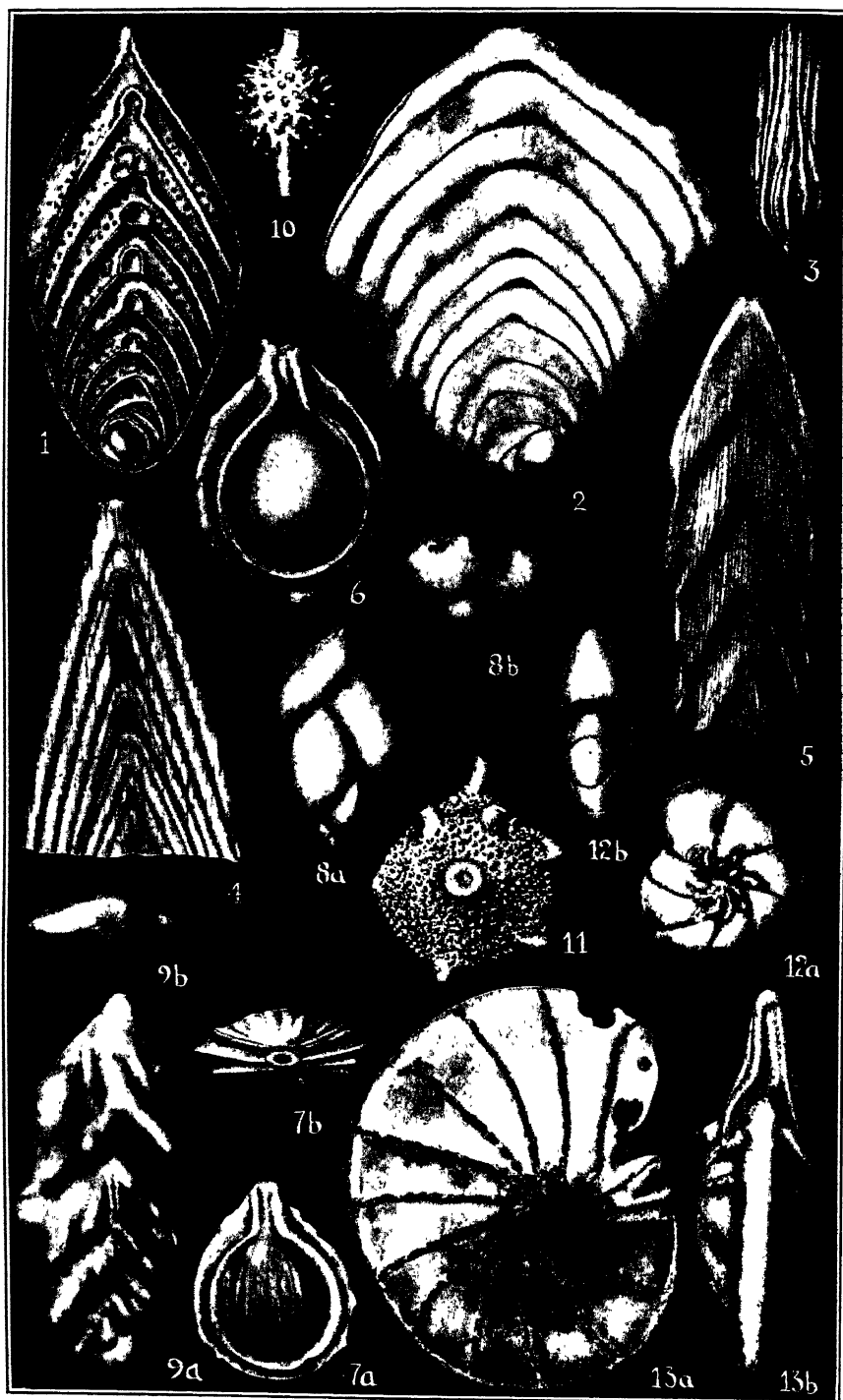
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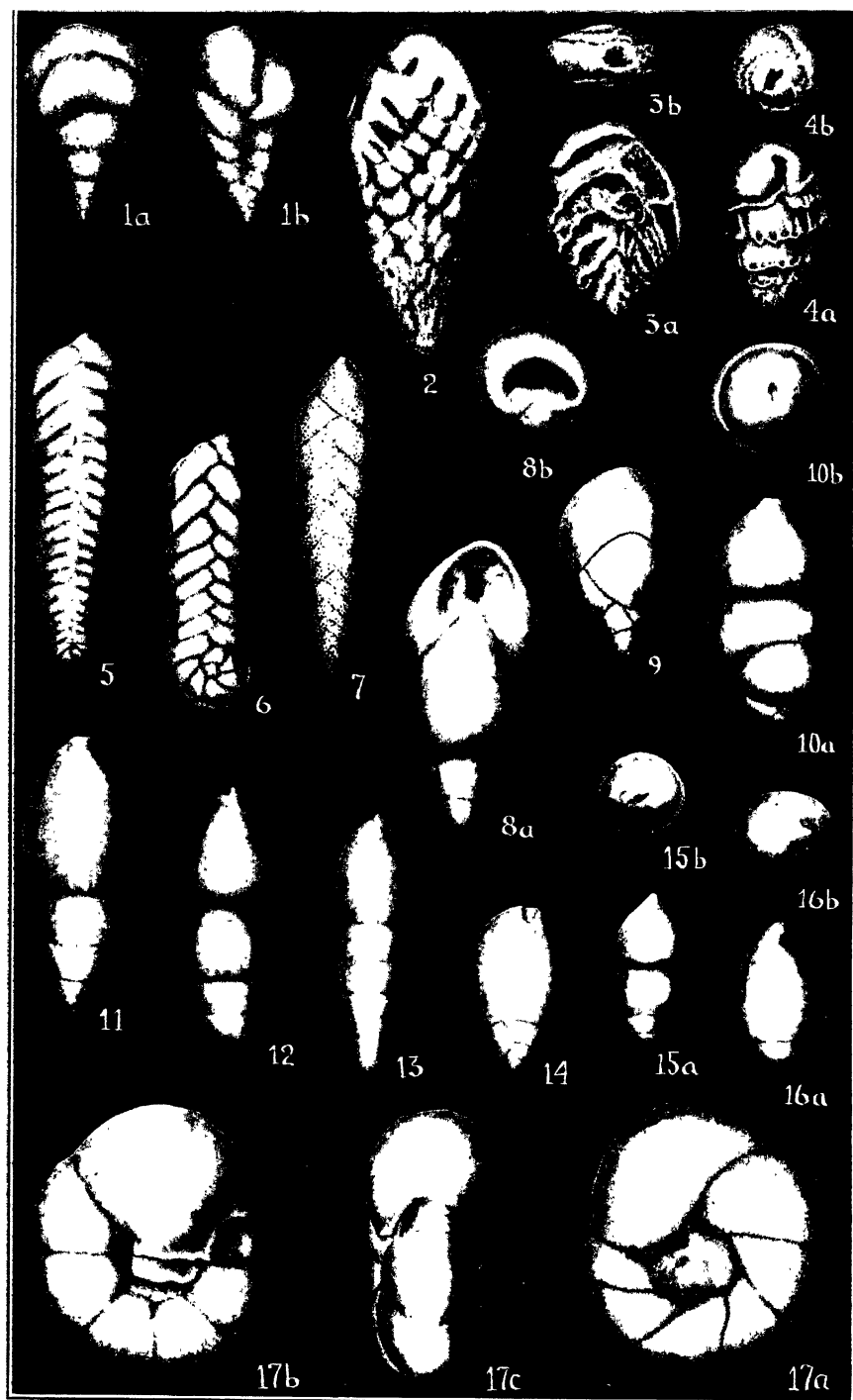
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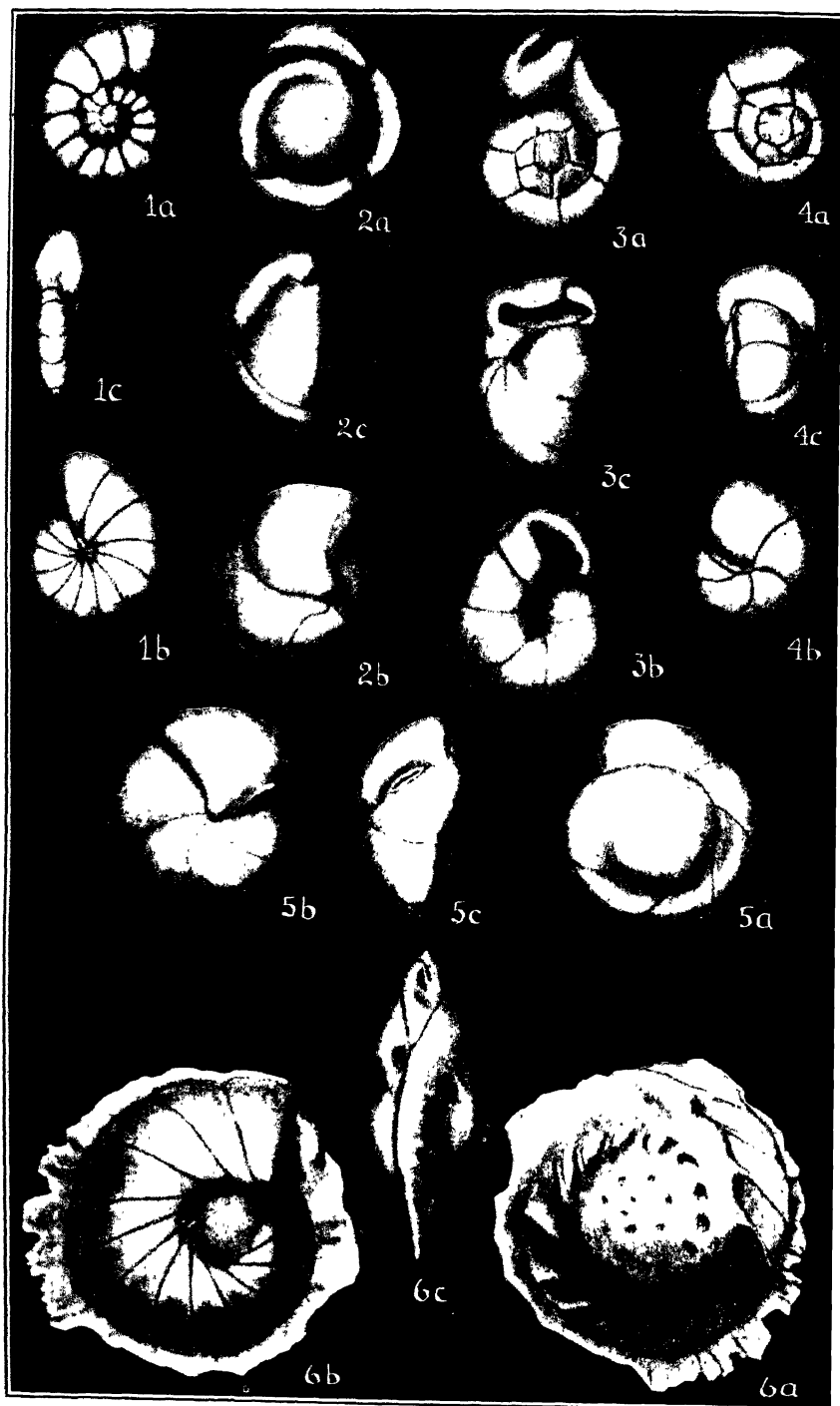
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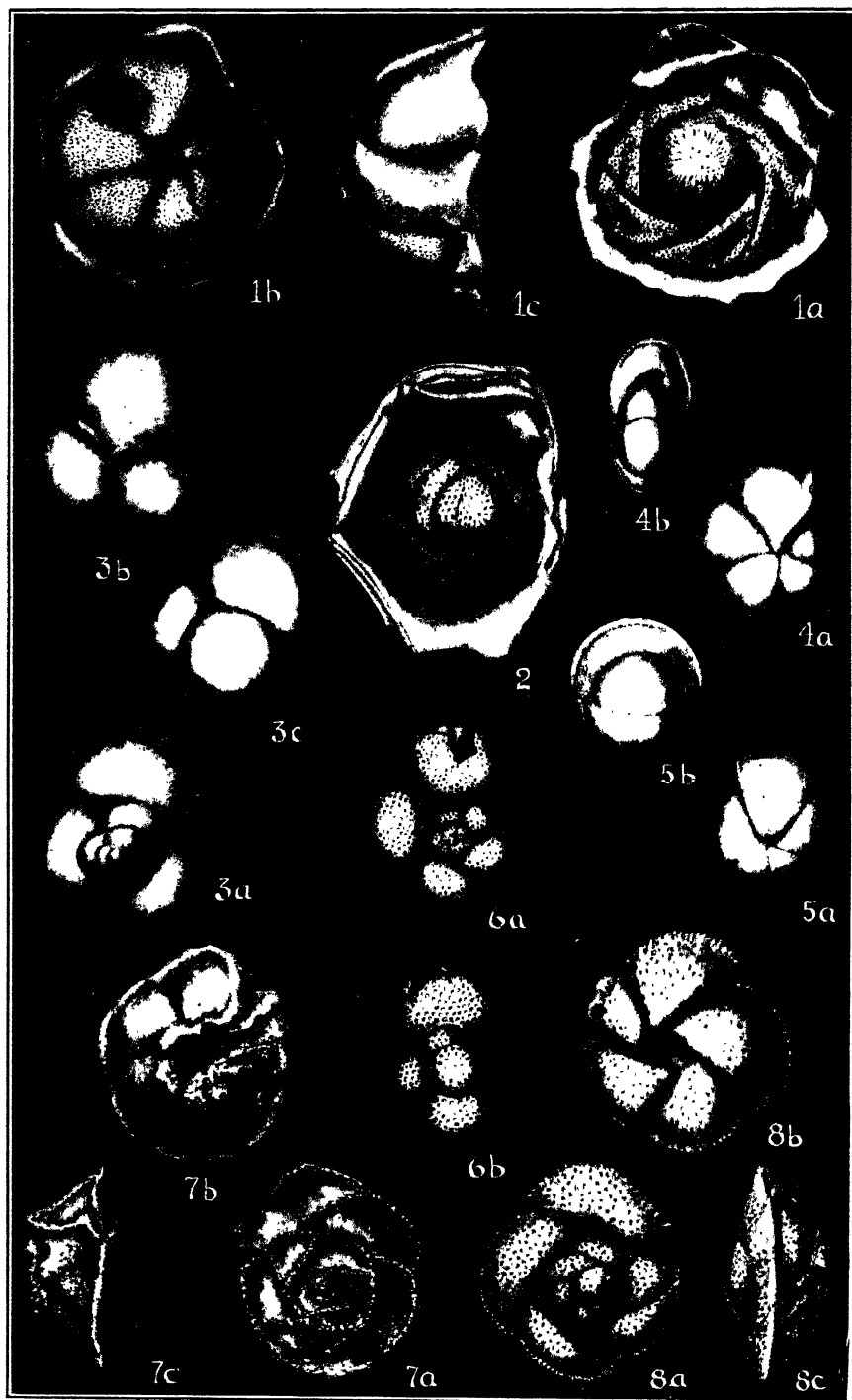
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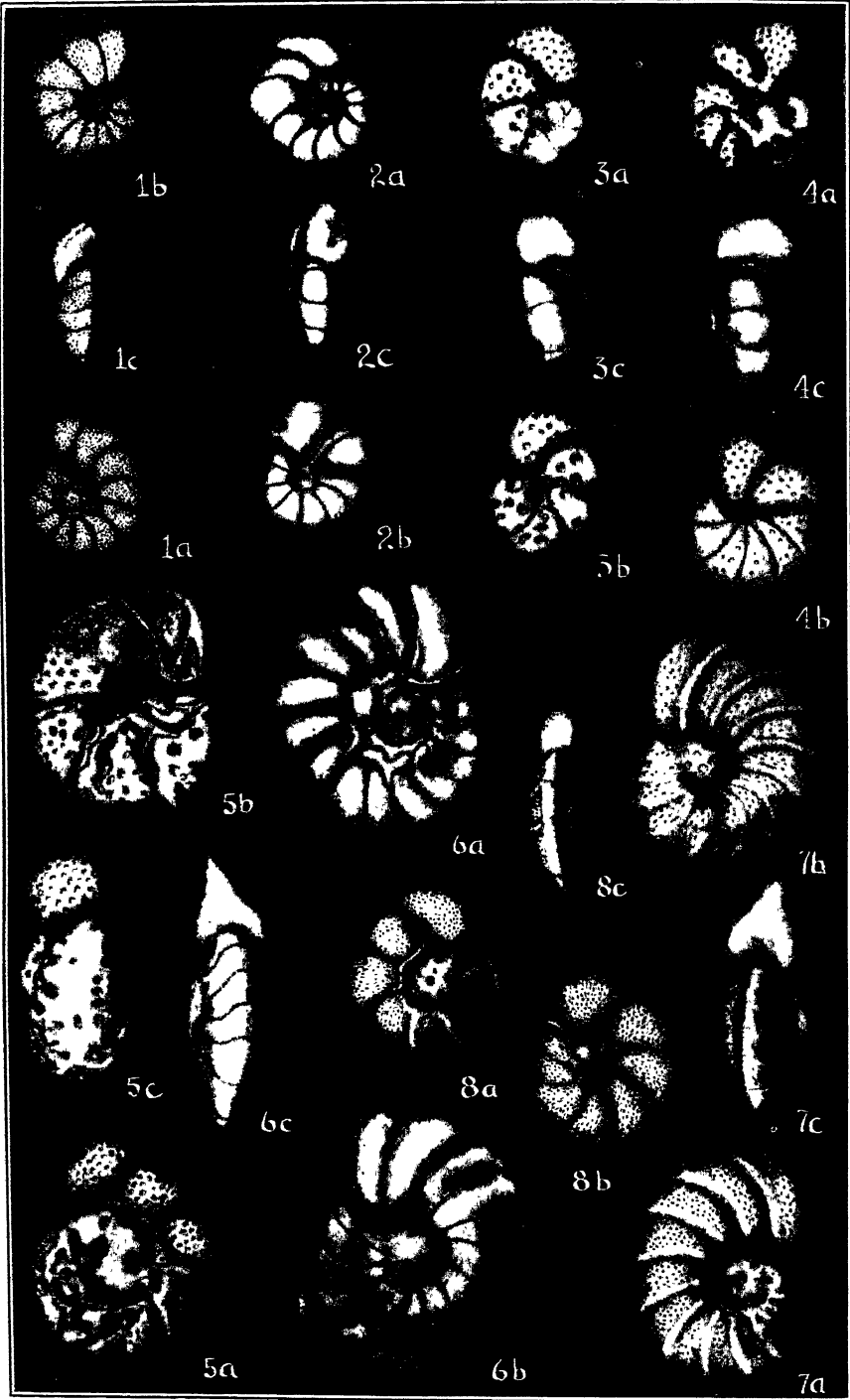
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FOR EXPLANATION OF PLATE SEE PAGE 60.

THE COPEPOD CRUSTACEANS OF CHESAPEAKE BAY

By CHARLES BRANCH WILSON

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INTRODUCTION

SOURCE OF MATERIAL

In 1915-16 and 1920-21 the United States Bureau of Fisheries conducted a biological and hydrographic survey of Chesapeake Bay. During the latter period the survey was under the immediate direction of Dr. R. P. Cowles, of Johns Hopkins University, and the copepods then collected by him were separated from the rest of the plankton and turned over to the author for identification and study.¹

The material included about one thousand two hundred 2-ounce bottles, with some of larger capacity up to 16 ounces. In sorting and identifying this large quantity of material the author was very ably assisted during the summer of 1923 by his son, John E. Wilson, who separated and counted the species in the various hauls and computed most of the percentages in the accompanying lists. The author identified the species and is entirely responsible for the text of the report.

COMPARISON WITH OTHER STUDIES

Among the numerous plankton studies that have appeared in recent years, especially those more immediately concerned with the free-swimming copepods, there are practically none whose subject material was derived from a source like Chesapeake Bay. The copepod fauna of many bays and gulfs has been studied, at times with considerable intensity, as in the case of the Gulf of Naples, Liverpool Bay, and the Bay of St. Andrews in Europe, and the Gulf of Maine and Narragansett Bay on the North American coast. Such gulfs and bays, however, are little more than partially restricted bodies of salt water, and not enough fresh water enters them to exert an appreciable influence.

¹ The results of the study as a whole have been published by the Bureau of Fisheries as follows: Cowles, R. P., A Biological Study of the Offshore Waters of Chesapeake Bay, Bull. Bur. Fisheries 46 (Fisheries Doc. 1091), pp. 277-381, 16 figs., 1930.

Excellent work has been done by Thomas Scott upon the Firth of Forth and by Giesbrecht on the Kieler Föhrde. But even these, while subject to vigorous tidal fluctuations, do not receive a sufficient influx of fresh water to modify sensibly their salinity and temperature. The rivers entering them are few and comparatively small, and the volume of water that they contribute is absorbed and neutralized almost immediately.

PECULIAR CONDITIONS OF CHESAPEAKE BAY

Chesapeake Bay differs from all that have been mentioned and from most other bays in the world in several particulars, which become of vital importance when considering its plankton.

Size.—Chesapeake Bay extends almost exactly north and south and in length covers $2\frac{3}{4}^{\circ}$ of latitude, or approximately 200 miles. Its width varies from a few miles near the upper end to 30 miles or more near the mouth of the Potomac River.

Depth.—Chesapeake Bay, according to geologists, is a submerged river mouth; that is, all the rivers of eastern Virginia and inner Maryland formerly united in a common trunk river which flowed across the present coastal plain and a part of what is now the continental shelf. During the subsequent depression of the Atlantic coast the lower valleys of this river system were submerged to form Chesapeake Bay. Hence it is comparatively shallow over the greater portion of its area, from 10 to 20 meters deep. At only four localities did the depth exceed 30 meters, and at only four others did it fall below 10 meters. Notwithstanding its great size, therefore, it becomes quite susceptible to the influx of fresh water by reason of its shallowness.

Tributaries.—Six large rivers flow into the bay, one at the extreme upper end, the others along the western shore. These include three of the longest rivers east of the Alleghenies—the Susquehanna, the Potomac, and the James. The other three, the Patuxent, the Rappahannock, and the York, are shorter. Among the small rivers may be mentioned the Patapsco and the Gunpowder, entering the bay from the west, and the Elk, the Chester, the Choptank, the Nanticoke, the Wicomico, and the Pocomoke from the east. In addition to these are a multitude of tiny rivers, streams, creeks, and runs, all of which contribute to increase the quantity of fresh water poured into the bay. The combined result is a volume amply sufficient to modify materially the water of the bay, and to transform it into an ever-changing mixture of salt and fresh water.

Salinity.—Since fresh water is lighter than salt water, it has a tendency to remain near the surface, while the heavier salt water stays near the bottom. There are thus produced remarkable differences in

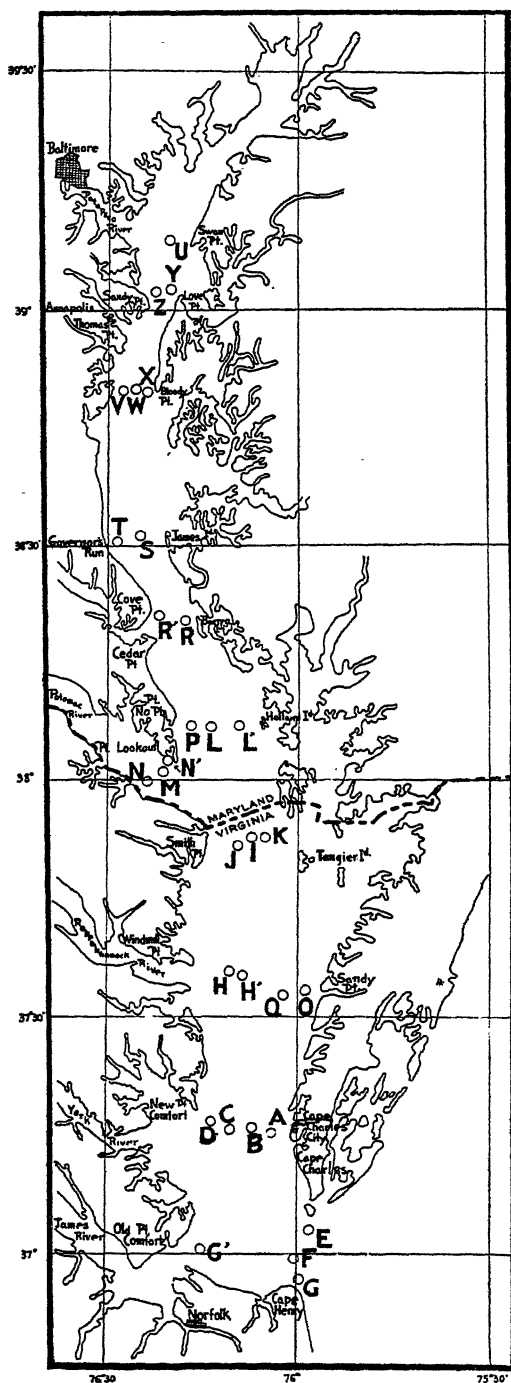


FIGURE 1.—Chesapeake Bay biological and hydrographic stations, 1915-16 and 1920-21. Map from Fisheries Document 1091, reproduced by courtesy of the Bureau of Fisheries.

salinity between the surface and the bottom, even where the water is very shallow. In water from 15 to 20 meters deep it is not at all unusual to find the salinity at the bottom from two to two and a half times as great as at the surface. At Station U (fig. 1), opposite the mouth of the Patapsco River, where the water is only 11 meters deep, the salinity at the bottom is occasionally four times that at the surface.

Temperature.—In temperature just the reverse is true: There is an equalization instead of a differentiation. On August 21, 1920, the difference in temperature between the surface water and the bottom water of the outside ocean at a depth of 20 fathoms was more than 16° C. At the deepest station (G) in the mouth of the bay on the following day the difference was 11.5° , but at Station B, 20 miles up the bay, it was only $2\frac{1}{2}^{\circ}$. At practically every station in the bay except the three at the very mouth the difference between the surface and bottom temperatures was less than 2° and often less than 1° . Even at Station R, where the water was 47.5 meters deep, considerably more than 20 fathoms, there was a difference of less than $1\frac{1}{2}^{\circ}$. But at the same time large areas of very shallow water along shore may be heated during summer to a comparatively high temperature compared with the deeper water.

Also, during spring the quantity of fresh water poured into the bay is greatly increased, while during the late summer and early fall it is considerably diminished. Hence the resultant combinations vary greatly with the seasons. The changes produced by all this intermingling of tide and seasons, temperature and salinity are much the same as those in the old-fashioned kaleidoscope. Each combination is different from all the others, and there are never any exact repetitions.

NETS EMPLOYED

In collecting the material four kinds of nets were used, called, respectively, "stramin net" and Nos. 6, 18, and 20. The stramin net had the coarsest and No. 20 the finest mesh. Each net was usually towed for 10 minutes and then emptied. Sometimes two or three nets of different mesh were towed successively at the same station with contrasting results. The vertical net was a large tow net of medium mesh, lowered to the bottom and then immediately drawn to the surface. Its contents, of course, included material from every stratum of depth, with no possibility of determining the level from which any given specimen was obtained. The bottom net was one of medium mesh, fastened to a beam trawl frame and towed along the bottom for 10 minutes. Most of its contents would be bottom material, but as the net was nonclosing copepods could get into it while it was being lowered and raised.

DISTRIBUTION OF SPECIES

The distribution of the copepods in the bay may be considered with reference to their geographical location, the depth and salinity of the water, the time of day, the state of the tide and the kind of bottom, and the time of year when they are present in greatest abundance. It will be found convenient to discuss these different points of view under separate headings.

GEOGRAPHIC DISTRIBUTION

Species universally distributed.—The following 10 species (see Table 1) may be designated as universally distributed in the bay: *Acartia clausii*, *A. longiremis*, *Centropages hamatus*, *C. typicus*, *Harpacticus gracilis*, *Oithona brevicornis*, *O. similis*, *Paracalanus parvus*, *Pseudocalanus elongatus*, and *Pseudodiaptomus coronatus*.

The two species of *Acartia* were present in practically every haul, and numerically constituted nearly two-thirds of the entire collection. The two species of *Centropages* were absent from comparatively few hauls, chiefly at the inner end of the bay. The *Harpacticus* species was found in every part of the bay and at 23 of the 31 stations, but only in limited numbers. *Oithona brevicornis* was nearly as universal as the *Acartia*, occurring at every station except U, but nearly always in much smaller numbers; *O. similis* was present at all the stations except four, but in even smaller numbers than *brevicornis*. The three remaining species were found at most of the stations, but seldom did they constitute more than 1 or 2 per cent of the total. *Microthalestris littoralis* was also widely distributed throughout the bay but in such small numbers and at so few (13) of the stations that it can hardly be classed as universal.

Inner-bay species.—Table 1 also shows 10 species that may be designated as belonging to the inner portion of the bay. The division between the inner and outer portions falls naturally at the Maryland-Virginia State line at the mouth of the Potomac River. These species are *Canuella elongata*, new species, *Cletodes longicaudatus*, *Dactylopusia brevicornis*, *Ectinosoma normani*, *Eurytemora americana*, *E. hirundoides*, *Harpacticus littoralis*, *Metacyclops gracilis*, *Robertsonia chesapeakeensis*, new species, and *Tachidius littoralis*.

The new species of *Canuella* was obtained at Stations W and Z, near the extreme inner end of the bay. The *Cletodes* species was confined to Station R, off Barren Island, just above the mouth of the Patuxent River. *Dactylopusia* and *Ectinosoma* also occurred at single stations, the former at N' and the latter at Y. The two species of *Eurytemora* were found very sparingly in the outer bay, but quite abundantly in the inner bay. *Harpacticus littoralis* was confined to Stations R', S, and T. *Metacyclops gracilis* appeared in a single haul

at Station Z, the new species of *Robertsonia* in a single haul at Station T, and *Tachidiu littoralis* in single hauls at Stations L' and N'.

Outer-bay species.—In contrast with the littoral species just enumerated, 16 others may be regarded as belonging to the outer portion of the bay. These are *Alteutha depressa*, *Calanus finmarchicus*, *Corycella carinata*, *Corycaeus elongatus*, *C. venustus*, *Cryptopontius gracilis*, *Diosaccus tenuicornis*, *Harpacticus chelifer*, *Labidocera wollastoni*, *Microsetella norvegica*, *Oithona spinirostris*, *Oncaea minuta*, *Pontella meadii*, *Temora longicornis*, *T. turbinata*, and *Tisbe furcata*.

Eight of these species were confined to single hauls at different stations, two appeared at two stations each, and three at four stations each. Of the remaining species, *Calanus* occurred fairly abundantly in the wider portion of the bay below the mouth of the Potomac River. The first species of *Temora* was found at the three stations in the mouth of the bay and also at Station Y near the extreme inner end of the bay. The other species, *Temora turbinata*, was most abundant at the mouth of the bay and only went up as far as the mouth of the Rappahannock River.

The parasitic species, *Bomolochus eminens*, was found in the adult stage only at Station P in the inner bay, but development stages were very common at nearly every station in the outer bay. The geographic location of these parasites, however, is determined by the distribution of their hosts rather than by any locality where they happen to be captured swimming freely in the tow.

Oceanic species.—A fourth division would include such species as were not found at any of the stations within the limits of the bay, but were present more or less abundantly in the outside ocean. There are 19 such species, and they will be found discussed on page 16 under the trip to the 100-fathom line.

SALINITY DISTRIBUTION

The salinity records made during the investigation vary all the way from 31.74 per cent on the bottom at Station G in the mouth of the bay down to 4.75 on the surface at Station U, the innermost station opposite the mouth of the Patapsco River. If we recall, in connection with this remarkable range in salinity, what has already been said with regard to the kaleidoscopic changes produced by the tides and the seasons, certain deductions naturally follow:

1. The 10 species universally distributed, especially the two *Acartias* and *Harpacticus gracilis*, must be able to accommodate themselves to great and fairly rapid changes in salinity. The three species mentioned were taken in surface hauls at Stations G and U, and the two *Acartias* also appeared in the bottom hauls. The depth

at Station U was only 11 meters, but the bottom salinity was about three times that at the surface. If these species migrate daily up and down as they are known to do elsewhere, the change in salinity must be more or less abrupt in so short a distance.

2. The 10 copepods found exclusively or most abundantly in the inner bay may be regarded as brackish-water species, since they were found in water with an average salinity of 15 per cent or less. They also are probably able to accommodate themselves to rapid changes in salinity, especially to those involving reduction.

3. The 16 species found exclusively in the outer bay may be regarded as salt-water forms. They were found in water with a salinity ranging between 20 and 30 per cent, and the changes are not so great as for the other two groups.

4. The 14 species confined to single areas in the bay will be considered separately, since salinity may have been one of the factors determining their distribution. Table 2 gives the complete statistics with reference to these species and will serve for the other aspects of distribution as well as for that of salinity.

The *Cletodes* species has been recorded from various European localities, all of which were considerably farther north. No record of the salinity of the water in which the specimens were found has been given, but judging from the localities it seems probable that it was higher than that here recorded. The single species of each of the genera *Corycaeus*, *Corycella*, *Diosaccus*, *Harpacticus*, and *Oithona*, together with the new species of *Pontella*, were all taken in water of normally high salinity, between 25 and 30 per cent. Giesbrecht described four species of *Cryptopontius* from the Bay of Naples, and Sars reported one of them from the south coast of Norway. They were all bottom forms, but nothing was said about the salinity of the water in which they were found. The new species here recorded comes also from the bottom at one of the deepest stations near the mouth of the bay, where the salinity is fairly high. *Ectinosoma normani* was first recorded from the Firth of Forth in Scotland and afterwards from Vadso, Finmark, and the upper part of the Christiania Fiord in Norway, from a depth of 6 fathoms on a muddy bottom. The present specimens came from near the inner end of the bay, at about twice the depth (20 meters) on a muddy bottom where the salinity was low. The *Labidocera* species has been reported by Giesbrecht from the Atlantic Ocean between latitude 36° and 55° N. The mouth of the bay where the present specimens were obtained is on the parallel of latitude 37° N., and the salinity is but little less than that of the open ocean. *Metacyclops* is a fresh-water copepod, found in lakes and rivers all over the world. Here it was obtained just below the mouth of the Patapsco River,

TABLE 2.—Complete statistics of species of copepods confined to single stations

Species	Station	Date	Time	Tide	Temperature °C.	Bottom	Depth Meters	Salinity Per cent	Net
<i>Cletodes longicaudatus</i>	R	Dec. 8, 1920	3 p. m.	¼ flood	+9.9	Mud, sand	47.5	19.85	Bottom.
<i>Corycaeus elongatus</i>	C	Oct. 20, 1920	5.40 p. m.	¼ flood	+19.5	Mud, gravel, sand	12.5	26.44	Bottom.
<i>Corycaeus carinata</i>	G	Dec. 4, 1920	4.45 p. m.	¼ flood	+11.6 av.	Mud, sand	23	25-30.9	Vertical.
<i>Cryptopontius gracilis</i>	A	Dec. 5, 1920	10.40 a. m.	¼ flood	+10.3	Mud, sand	46	23.98	Bottom.
<i>Dactylopusia brevicornis</i>	N'	Dec. 7, 1920	8.45 a. m.	¼ flood	+8.9	Mud	10.5	15.61	Surface.
<i>Dioscaena tenuicornis</i>	F	Dec. 4, 1920	6 p. m.	Full flood	+10.8 av.	Mud, sand	16	26.53 av.	Vertical.
<i>Ectinosoma normani</i>	Y	Jan. 27, 1921	12.45 p. m.	¼ ebb	+8.8	Mud	20	14.46	Bottom.
<i>Harpaecticus thelleri</i>	G	Dec. 4, 1920	4.45 p. m.	¼ flood	+10.5	Mud, sand	23	22.73	Surface.
<i>Labidocera wollastoni</i>	G	Aug. 22, 1920	10.40 a. m.	¼ ebb	+27	Mud, sand	23.5	22.73	Surface.
<i>Metacyclops gracilis</i>	Z	Oct. 17, 1920	8 a. m.	¼ flood	+19.5	Mud	13	10.42	Surface.
<i>Oithona spinirostris</i>	G	Dec. 4, 1920	4.45 p. m.	¼ flood	+10.5	Sand, mud	23	25.20	Surface.
<i>Pontella pinnata</i>	C	Oct. 20, 1920	5.40 p. m.	¼ flood	+19.5	Mud, gravel, sand	12.5	26.44	Bottom.
<i>Robertsonia chesapeakeensis</i>	T	Mar. 29, 1921	4.10 p. m.	Flood	+9.9	Mud, sand	10	11.60	Bottom.
<i>Tisbe furcata</i>	G'	Dec. 4, 1920	12.30 p. m.	Full ebb	+9.6	Sand, mud, shells, clay	28	14.78	Surface.

where the salinity was very low. It was probably swept down by the current from the river into the bay. The new species of *Robertsonia* was captured in the upper central portion of the bay in water that had a depth of 9 meters over a muddy bottom, where the salinity was only 11.5. The type species of the genus has been reported by Brady and Scott from various localities around the British Isles, and by Sars from the upper part of the Christiania Fiord, but no data were given on salinity.

In general, therefore, eight of these species confined to single stations compare favorably with those from other regions in depth, salinity, and kind of bottom. In the case of five of the other species the salinity is presumably lower than that of the water from which they have previously been recorded. The remaining species, the fresh-water form, has been explained above.

SEASONAL DISTRIBUTION

In Table 1 the seasonal distribution is given for all the species obtained in the bay, the letters denoting the seasons of the year when the species was obtained in greatest abundance at the respective stations. In determining abundance, consideration must be given to both the percentage of the catch and the total number of specimens obtained. Five per cent of a catch totaling 10,000 specimens is manifestly a larger number than 80 per cent of a catch totaling 500 specimens, although at first it may appear much smaller. It is freely admitted that the seasonal abundance of any species at a given station may be largely modified by accidental or exceptional conditions, but when the records of all the stations at which the species was obtained are compared the information becomes fairly reliable. The more universally the species is distributed throughout the bay the more trustworthy become the inferences as to its seasonal distribution.

The two species of *Acartia* seem to have been equally distributed throughout the year. The total number of specimens was greatly increased during March and slightly during August. Two hauls, each totaling 100,000 specimens, and two of 25,000 each, were made during March, and these are the four highest totals obtained during the entire survey. These large hauls are the result, however, of the breeding season, which immediately preceded them, and in spite of the fact that they are made up almost entirely of the two *Acartia* species the latter are not to be regarded as spring copepods only. They were present everywhere in the bay throughout the entire year and always in large numbers. Williams reported *A. clausii* as most abundant in Narragansett Bay during January and February, and Fish listed it as one of the winter species at Woods Hole. These

four largest hauls were obtained in bottom nets near the inner end of the bay where the salinity was quite low.

The two species of *Centropages* were manifestly winter forms, since they were entirely lacking at many of the stations during the summer, and often early in autumn and late in spring. They appeared during the autumn, were present practically throughout the bay during the entire winter, and remained into the spring. *C. hamatus* continued into the summer in the outer bay, and at three stations there it was even recorded as most abundant during the summer. *C. typicus* was found by Fish to be a summer form at Woods Hole and *hamatus* a winter form. Williams also found the latter species at Narragansett Bay during January and February.

Harpacticus gracilis was also a winter form in the outer bay, but in the inner bay it continued into the spring, and some of the spring hauls yielded more specimens than those of the winter.

Labidocera aestiva was an autumn copepod, appearing in the inner bay only during October, except a few stragglers obtained in December. In the outer bay it was more abundant in winter but was occasionally found in summer. It was also obtained August 21, 1921, at depths of 40 and 67 fathoms in the outside ocean. It was given by Wheeler as common at Woods Hole during July and early in August. Fish included it in his list of Woods Hole species as "a southern oceanic form blown in by winds from the Gulf Stream during warm weather."

Oithona brevicornis was fairly well distributed throughout the year, but it may be called a summer form in the outer bay and a spring form in the inner bay. In the outer bay it also occurred abundantly during the autumn and winter, but in the inner bay it was often exclusively a spring form and was not found at all at other seasons of the year at many of the stations. The two largest hauls of this species totaled 2,000 specimens each and were made one at Station C in October and the other at Station F in December. Station F is one of the three in the mouth of the bay, and Station C is only a short distance inside.

In contrast with the preceding species, *Oithona similis* was a pronounced winter form in both portions of the bay, being confined at many stations exclusively to that season. It was occasionally found also during the summer and autumn, but every large haul was made during the winter. This species was found in small numbers by Wheeler at Woods Hole in July and by Williams at Wickford, R. I., in the summer. Fish listed both species of *Oithona* as summer forms for the Woods Hole region.

Paracalanus was most abundant in autumn in the outer bay, appearing late in summer and lasting into the winter. In the inner

bay it was more of a winter species and was found only during the winter at the stations of the extreme inner end of the bay. The largest number of specimens in any one haul was 1,500, obtained in October at Station H. The number of specimens of this species diminished steadily in going up the bay and toward the inner end were reduced so low as to be unworthy of a percentage mark, only one or two being found in some winter hauls. It was common both at the surface and probably near the bottom in the outside ocean during August.

Pseudocalanus was more of a winter species in the outer bay and a spring species in the inner bay. Its seasonal distribution, however, was not well defined anywhere, and it was apparently likely to appear in small numbers during any month of the year and in any part of the bay.

Pseudodiaptomus was a decidedly winter form throughout the bay. It was nowhere very abundant, but proved to be the exact reverse of *Paracalanus*, its numbers increasing in going up the bay and reaching their maximum at Station Z, with Station V a close second. In the outer bay its numbers were reduced below a percentage value at several stations. This species was reported as a summer form in Narragansett Bay by Williams and in the Woods Hole region by Fish. Fish stated, however, that it was not a true summer species, but served as a connecting link between the summer and winter copepods. Sharpe reported it from Sheepshead Bay, N. Y., in September. In Chesapeake Bay it seemed to appear in summer in small numbers, continued through the autumn, reached its maximum early in winter, and then lasted into early spring at a few stations.

The species thus far considered are the 10 that were universally distributed. Of the others *Calanus finmarchicus* appeared only in the outer bay and during the winter. It was found, however, in goodly numbers in the outside ocean during August.

Ectinosoma curticorne was a winter species, especially in the inner bay, where it was much more abundant than in the outer bay. *Eurytemora americana* was found only in winter, except at the extreme inner end of the bay, where it appeared in March at Stations W and Z. The second species, *hirundoides*, was obtained chiefly during winter in the outer bay and during spring in the inner bay. The number of specimens taken increased decidedly in going up the bay. Both species of this genus were obtained by Williams in Narragansett Bay, but he did not give the seasonal distribution. Sharpe found *hirundoides* at Woods Hole in July, while Fish listed it as a winter form continuing into the spring.

Microthalestris appeared during every season of the year in the outer bay but was confined to winter and spring in the inner bay.

Oncaea minuta proved to be a summer form, appearing only once during the autumn. It was also obtained in summer, both at the surface and at the bottom, on the 100-fathom line in the outside ocean. *Temora turbinata* was entirely confined to autumn and winter, and with a single exception was found only in the inner bay.

Among species restricted to a few localities *Alteutha depressa*, *Cletodes longicaudatus*, *Corycella carinata*, *Cryptopontius gracilis*, *Dactylopusia brevicornis*, *Diosaccus tenuicornis*, *Ectinosoma normani*, *Harpacticus chelifer*, *Microsetella norvegica*, *Oithona spinirostris*, and *Temora longicornis* were obtained only in winter. *Candacia*, *Robertsonia*, and *Tisbe* appeared in spring, *Canuella* and *Hemicyclops* late in spring and summer, *Corycaeus elongatus*, *Temora discaudata*, and *Metacyclops* in autumn, *Corycaeus venustus* three times in autumn and once in winter, *Harpacticus littoralis* once in autumn and twice in winter, *Labidocera wollastoni* and *Pontella pennata* once in summer, *Pontella meadii* once in winter and three times in summer, and *Tachidius* once in autumn and once in winter.

Fish has listed *Alteutha* and *Dactylopusia* as summer species and *Microsetella* and *Tisbe* as winter species in the Woods Hole region. The new species of *Pontella* is also found there very commonly in summer and early in autumn.

To summarize, there were 3 species taken only in the spring, 3 only in the summer, 4 only in the autumn, and 18 almost only in the winter. The remainder showed a mixed seasonal distribution, being often more abundant at one season in the outer bay and at another season in the inner bay.

BREEDING SEASONS

Considered as a whole, the copepods showed a well-marked rhythm of development, which probably recurs yearly but whose seasonal proportions may vary considerably from year to year. There were apparently four breeding seasons, which were grouped about the months of January, April, July, and October. Each season begins toward the last of the month preceding and continues into the month following.

The first evidence of these breeding seasons was found in the presence of egg cases upon the adult females. Among the specimens captured during each of these breeding seasons there were always some, and often many, bearing eggs. For the January period were found such females of the two species of *Acartia*, the two species of *Centropages*, *Eurytemora hirundoides*, *Oithona brevicornis* and *O. similis*, *Paracalanus* and *Pseudocalanus*, and the new species of *Cryptopontius*. During the April period were found egg-bearing females of *Ectinosoma curticorne*, *Microthalestris*, *Pseu-*

docalanus, and the new species of *Robertsonia*. For the July period females of the two *Acartia* species again appeared bearing eggs, together with *Oncaea venusta*, *Oithona brevicornis* and *O. similis*, *Microthalestris*, *Pseudodiaptomus*, and the new species of *Canuella*. During the October period eggs were found upon females of *Pseudodiaptomus*, *Oithona similis*, *Harpacticus gracilis*, *Ectinosoma curticorne*, *Labidocera aestiva*, *Temora turbinata*, and the two species of *Centropages*.

Other evidence of these four breeding periods was found in the large number of development forms, nauplii, metanauplii, and cyclops stages, captured with the adults during the month following each period. These development stages in the tow proved that the eggs hatched a short time previously.

The breeding periods caused rhythmic fluctuations in the total numbers of specimens captured in the tow. It has already been noted that the four largest hauls were made in March. It may now be added that all the hauls made during that month had exceptionally high totals of specimens, although the hauls themselves were few in number. This may be designated as the first, or spring, maximum, and was the result of the January breeding season combined with certain favorable conditions. Chief among the latter may have been the relative scarcity of the fishes and other animals that prey upon the copepods. The four largest hauls, those of Stations S, T, V, and Z, were made up practically entirely of the two *Acartia* species. The fish that feeds most upon these copepods is probably the shad, and as soon as it becomes numerous in the bay during spring the copepods probably diminish rapidly. Ten different stations in the bay were visited during March, and the average number of specimens obtained at each of them was 36,500. Eight of the same stations visited in June yielded an average number of specimens of only 1,150, or less than a thirtieth as much.

Thus the spring maximum was followed by a long decline, which was only slightly modified by the April breeding season, and which reached its lowest point, the year's minimum, in June. The July breeding season brought the number of specimens rapidly up again, and it was still further increased during the October breeding period. The records give the following statistics: During January, 29 stations showed a total of 120,200 specimens, an average of 4,145. During March, 10 stations gave a total of 365,200, an average of 36,520. Two stations in April gave a total of 5,175, an average of 2,587. The total of 8 stations in May was 30,150, an average of 3,769. In June, 13 stations yielded a total of 14,900, an average of 1,146. Twenty-nine stations in July gave a total of 75,400, an average of 2,600. In August, 97,350 specimens were taken at 29 stations, an

average of 3,357. In October, the total of 28 stations was 116,000, an average of 4,143. In December, 27 stations yielded a total of 129,350 specimens, an average of 4,791.

There were thus four rises and four falls during the year, corresponding to the four breeding periods, but the rise in March and that in the following fall were much greater than the others. The lowest minimum was found in June and was probably the result of the increased abundance of young fishes and other animals that prey upon the copepods.

No development stages were found at any of the stations near the inner end of the bay, but no positive statement can be made with reference to the ability of any of the copepods to breed in water of low salinity. The records do indicate, however, that water of higher salinity is more favorable for breeding purposes, since development stages practically disappeared at the mouth of the Potomac River, and were not found in any numbers above there except at Station T.

TRIP TO 100-FATHOM LINE

Supplementing the survey of the bay, a trip was made to the 100-fathom line on August 21, 1920, to ascertain which of the species found in the bay were also present in the outside ocean and what species, common in the outside ocean, did not enter the bay.² Hauls were made with surface and bottom nets at depths of 118, 67, 40, and 20 fathoms, and on the following day at a depth of 10 fathoms.

Forty-one species were collected during this trip, an exceptionally large number, but all of them except one or two were obtained in sufficient numbers to show that they were at least common. Nineteen species, designated in Table 3 by footnote 2, were not found inside the bay. The other 22 species were found both in the bay and in the ocean, and included every one of the 10 species that were universally distributed throughout the bay.

In contrast with this, 23 species, including all the new forms, were present in the bay but were not found in the ocean. These are designated by footnote 3 in Table 1, giving the seasonal distribution of the species.

The species found in greatest numbers in the ocean proved to be *Centropages typicus*. Next to this came *Paracalanus parvus* and then in order *Calanus finmarchicus*, *Metridia lucens*, *Candacia*

² In lieu of the original chart of the stations outside of Chesapeake Bay, which seems no longer to be extant, Dr. R. P. Cowles, in charge of the survey, has furnished the following information regarding their position:

"Our log shows that Station 8832 was on the 100-fathom curve where a line, run E. 5/8 S. from the whistle buoy 'FIR' off Cape Henry, cuts in. Stations 8833, 8834, 8835, and 8836 were on the 60, 40, 20, and 10 fathom curves, respectively, where the same line mentioned cuts them. I feel quite certain that the line follows the compass course."

TABLE 3.—Record of trip to the 100-fathom line, August 21-22, 1920

Time.....	5.40 p. m.		7.25 p. m.		9.00 p. m.		11.25 p. m.		6.00 a. m.	
Tide.....	$\frac{1}{4}$ flood		$\frac{1}{2}$ flood		$\frac{3}{4}$ flood		Slack flood		Ebb	
Salinity.....			29.7-34.4		29.9-33.3		29.7-33.5			
Depth.....	118 fathoms		67 fathoms		43 fathoms		20 fathoms		10 fathoms	
Net ¹	Sur-face	Bot-tom	Sur-face	Sur-face	Bot-tom	Bot-tom	Bot-tom	Sur-face	Bot-tom	
SPECIES COLLECTED		PER CENT OF TOTAL SPECIMENS								
<i>Acartia clausii</i>	5	2	5	2				30	5	
<i>Acartia longiremis</i>	20		³ T.					T.		
<i>Amalophora brevicornis</i> ²		2								
<i>Anomalocera patersoni</i> ²		T.								
<i>Calanus finmarchicus</i>		35								
<i>Calanus helgolandicus</i> ²					20	20				
<i>Candacia armata</i>	T.	2		10	25				15	
<i>Centropages bradyi</i> ²	T.		T.		T.					
<i>Centropages hamatus</i>	10									
<i>Centropages typicus</i>	25	10	60	80	50	45				
<i>Clytemnestra rostrata</i> ²	1		T.							
<i>Corycaeus elongatus</i>				T.						
<i>Corycaeus lubbockii</i> ²	1									
<i>Corycaeus robustus</i> ²	1	1								
<i>Corycaeus rostratus</i> ²	1									
<i>Corycaeus speciosus</i> ²	T.									
<i>Corycaeus venustus</i>	1	1								
<i>Corycella carinata</i>	1									
<i>Euchaeta norvegica</i> ²		T.								
<i>Harpecticus gracilis</i>						3				
<i>Labidocera aestiva</i>			2	T.						
<i>Macrosetella gracilis</i> ²			3							
<i>Mecynocera clausii</i> ²		3								
<i>Metridia lucens</i> ²		25			5			3		
<i>Oithona brevicornis</i>			3	2					5	
<i>Oithona plumifera</i> ²		3				5				
<i>Oithona similis</i>		2				5	5	55		
<i>Oithona spinirostris</i>						2				
<i>Oncaea minuta</i>	1	3								
<i>Oncaea venusta</i> ²	2	3	20					2	5	
<i>Paracalanus parvus</i>	25	2	2	6		15	60	15		
<i>Pontella atlantica</i> ²		T.								
<i>Pontella meadii</i>	T.									
<i>Pontella pennata</i> , new species.....	T.									
<i>Pseudocalanus elongatus</i>		2				5				
<i>Pseudodiaptomus coronatus</i>	5		5							
<i>Rhincalanus nasutus</i> ²		T.								
<i>Sapphirina gemma</i> ²		T.			T.					
<i>Sapphirina sinuicanda</i> ²		1								
<i>Temora longicornis</i>	1									
<i>Tisbe furcata</i>		3								
Total number of specimens.....	5, 000	5, 000	3, 000	5, 000	2, 000	2, 000	500	100		

¹ 30-minute tows.² T. = trace.³ Found only in the outside ocean.

armata, and the two species of *Acartia*, with *A. longiremis* more abundant than *A. clausii* at the 100-fathom line but less abundant nearer the shore. Of these seven species most abundant in the ocean, only one, *Metridia lucens*, was not also found in the bay.

The other oceanic species require but little comment. *Calanus helgolandicus* was present in considerable numbers in the bottom nets hauled from depths of 40 and 20 fathoms. The *Corycaeus* species are minute and appeared only in the surface net at the 100-fathom line. *Macrosetella gracilis*, *Euchaeta norvegica*, *Mecynocera clausii*, *Oithona plumifera*, and *Rhincalanus nasutus* are all oceanic forms not likely to be found in the bay unless at the mouth. *Candacia armata* might properly be included with these oceanic species, since it was found in the 10, 40, and 100 fathom hauls. The few specimens obtained in one of the bottom nets at Station S in the inner bay were evidently exceptional.

The fact that three of the *Corycaeus* species were found in the outer bay suggests that it is not impossible for some or all the other three species to appear there in the future. The new species of *Pontella* is evidently a northern form since it has been taken abundantly in surface tows at Woods Hole, Mass., during the summers of 1923 and 1924. *Olytemnestra*, *Euchaeta*, *Mecynocera*, *Metridia*, *Oithona*, *Rhincalanus*, and *Macrosetella* are all widely distributed and are found in the Pacific as well as in the Atlantic Ocean. *Oncaea* and the two *Sapphirina* species are not so cosmopolitan, but the former genus and *Sapphirina gemma* have been found on our Atlantic coast as far north as Marthas Vineyard.

Some of these oceanic species have not been reported before from our American coasts, and others have not previously been found as far south as the mouth of Chesapeake Bay. These will each be noted under the remarks given for the separate species in the following pages.

DISCUSSION OF THE SPECIES

The classification of the Copepoda proposed by Sars appears to be the simplest and most rational one thus far advanced. Accordingly the species are here arranged in the four groups, or suborders—Calanoida, Harpacticoida, Cyclopoida, and Caligoida—but since this is an account of the species found in a definite locality and not a systematic treatise, it seems wise to arrange the species in each group alphabetically and to omit family, generic, and specific diagnoses, except for new species or for those especially figured.

Suborder CALANOIDA

ACARTIA CLAUSII Giesbrecht

Acartia clausii GIESBRECHT, Fauna und Flora des Golfes von Neapel, vol. 19, Pelagische Copepoden, p. 507, pls. 30, 42, and 43, 1892.

Acartia clausi G. O. SARS, Crustacea of Norway, vol. 4, p. 150, pl. 101, 1903.

Occurrence.—Taken at every station in the bay, in the surface, the bottom, and the vertical nets. Most abundant in March after the winter breeding season.

Remarks.—This species is undoubtedly the chief component of the copepod fauna of the bay. Repeated hauls by every kind of net used during the survey yielded no other *Acartias* except these. The proportion of the two *Acartia* species, however, usually averaged about 3 specimens of *clausii* to 2 of *longiremis*. *A. clausii*, therefore, occupies in Chesapeake Bay a position corresponding to that of *Calanus finmarchicus* in the Gulf of Maine and elsewhere along the northern Atlantic coast. The total numbers of specimens captured furnish a good idea of the absolute abundance of these two *Acartia* species in the bay. The great majority of these totals run into the thousands, 20 of them are 10,000 or more, and 2 of them were estimated at 100,000 each. And yet practically none of the nets was towed longer than 10 minutes.

In view of such large numbers, these two species very likely form the bulk of the plankton food supply in the bay. This fact necessarily gives them great economic value, and they should no longer be regarded as merely two species of minute crustaceans possessed of moderate scientific interest. They may well assume a place of vastly higher importance in the life of the bay and take their stand beside the shad and the oysters, and the crabs and the terrapin, as one of the valuable resources of the bay.

In a paper by Prof. Arthur Willey, of McGill University, on the distribution of free-living Copepoda in Canadian waters^{*} it was said that the stomach contents of shad, caught at Scotsman Bay, Nova Scotia, was a copious chyme made up almost wholly of *Acartia clausii*. The presence of the shad in such abundance in the bay, therefore, may be directly the result of the abundance of food awaiting them there.

Sars said of this species that it seemed to be a more southern form than *longiremis*, and this assumption is fully borne out by a comparison of the relative abundance of the two species in the Gulf of Maine and in Chesapeake Bay. In the former locality *longiremis* is much more abundant than *clausii*, but in the bay the proportion is reversed. Farran reported the present species as taken all through

^{*} Cont. to Biol., vol. 1 (new ser.), no. 16, pp. 305-334, 1923.

the year on the mackerel-fishing grounds of Ireland, but as becoming more numerous in autumn. He also said that *longiremis* was not found there at all, and hence did not share with *clausii* in furnishing food.

In a continuous collection of plankton from Liverpool to Quebec, made by W. A. Herdman in 1897, these two *Acartia* species were taken along the English and American shores but disappeared entirely in the open ocean. Hence they may be regarded as littoral rather than pelagic species, well suited to such a region as Chesapeake Bay.

ACARTIA LONGIREMIS (Lilljeborg)

Dias longiremis LILLJEBORG, De Crustaceis ex ordinibus tribus in Scania occurrentibus, p. 181, pl. 24, 1853.

Acartia longiremis G. O. SARS, Crustacea of Norway, vol. 4, p. 149, pls. 99, 100, 1903.

Occurrence.—Taken at every station in the bay, in the surface, the bottom, and the vertical nets; most abundant in March.

Remarks.—Sars, in the reference given above (p. 150), said of this species: "It is a true pelagic form, being often met with far out at sea, and at the very surface. Not unfrequently, however, it is brought by the current close to shore; and it is even often found in tidal pools together with *Paracalanus parvus* and *Temora longicornis*." Its abundant distribution in Chesapeake Bay shows also that it may become essentially a littoral form. Its presence there is not dependent upon currents or tide pools; it is indigenous to the bay and forms one of the two chief constituents of the copepod plankton. Furthermore, it is just as abundant in the brackish water of the inner bay as in the outer bay, the salinity of which is nearly as high as that of the ocean.

This species occupies a position next to *A. clausii* and shares with the latter its economic importance as a component of the plankton food supply. Though its proportion to *clausii* is usually that of the 2:3 ratio already mentioned, it frequently falls to 20, 10, or even 5 per cent. Usually, however, it maintains a good average, and rarely it exceeds the former species in numbers.

AMALLOPHORA BREVICORNIS G. O. Sars

Scolecithria brevicornis G. O. SARS, The Norwegian North Polar Expedition, Crustacea, p. 46, pl. 10, 1900.

Amallophora brevicornis G. O. SARS, Crustacea of Norway, vol. 4, p. 53, pl. 36, 1902.

Occurrence.—Obtained only in the bottom net at the 100-fathom line in the ocean outside the bay.

Remarks.—A pelagic form not likely to be found in the bay but not before reported from American shores.

ANOMALOCERA PATERSONI Templeton

Anomalocera patersoni TEMPLETON, TRANS. ENT. SOC. LONDON, vol. 2, p. 35, pl. 5, figs. 1-3, 1837.—G. O. SARS, CRUSTACEA OF NORWAY, vol. 4, p. 139, pls. 92-94, 1902.

Occurrence.—A few specimens were obtained in the bottom net at the 100-fathom line in the outside ocean.

Remarks.—Wheeler remarked that it appeared at Woods Hole, Mass., only after stormy weather and prevailing southwest winds. If it could be blown in there from the Gulf Stream, it might be carried into Chesapeake Bay from the 100-fathom line. Brady said that it is generally distributed over the Atlantic Ocean and the North Sea, as well as in the Mediterranean, and that it often occurs in large numbers.

CALANUS FINMARCHICUS (Gunnerus)

Monoculus finmarchicus GUNNERUS, ACTA HAFNIA, vol. 10, p. 175, figs. 20-23, 1765.

Calanus finmarchicus G. O. SARS, CRUSTACEA OF NORWAY, vol. 4, p. 9, pls. 1-3, 1901.

Occurrence.—Confined to the outer bay and found there only during winter and mostly at the surface. Apparently abundant in the outside ocean during summer.

Remarks.—This very cosmopolitan and widely known species is extremely abundant on our Atlantic coast farther north. In the Gulf of St. Lawrence and the Gulf of Maine it constitutes the bulk of the plankton. At the latitude of the mouth of Chesapeake Bay (37° N.), it does not seem to be so abundant. The fact that it was found only in the outer bay and was confined to the winter season corroborates the opinion that it is essentially a northern form. The latitude of this bay is probably near the southern limit of its distribution on our Atlantic coast.

CALANUS HELGOLANDICUS (Claus)

Oetochilus helgolandicus CLAUS, DIE FREI LEBENDEN COPEPODEN, p. 171, pl. 26, figs. 2-9, 1863.

Calanus helgolandicus G. O. SARS, CRUSTACEA OF NORWAY, vol. 4, p. 11, pl. 4, 1901.

Occurrence.—Found in considerable abundance in the bottom net from depths of 40 and 20 fathoms in the outside ocean.

Remarks.—Sars regarded this as more of a southern species than *C. finmarchicus*, and suggested that the two have generally been confused by various authors. He apparently succeeded in differentiating the two species, and his decision has been accepted by Scott and by Pearson but not by some other authors. Among the latter, With devoted a long discussion to the solution of the question

whether Sars was right or wrong in separating the species, but he finished without coming to any conclusion. The reasons given by Sars would seem fully as valid as those for many of the regularly accepted species.

CANDACIA ARMATA (Boeck)

Candace armata BOECK, Christiania Videnskabeliger Selskabet Forhandler, p. 39, 1872.

Candacia armata G. O. SARS, Crustacea of Norway, vol. 4, p. 135, pl. 91, 1902.

Occurrence.—Found at Station S in one of the two largest hauls made in the bay, with a bottom net on March 29 in water 23 meters deep. Fairly common in the outside ocean.

Remarks.—This copepod was captured both at the surface and in the bottom net in the outside ocean. It is rather remarkable that it should have been captured but once within the bay and then so far above the center. It would seem as if it might be found some time at other places, especially in the outer bay.

CENTROPAGES BRADYI Wheeler

Centropages bradyi WHEELER, Bull. U. S. Bur. Fisheries, vol. 19, p. 174, fig. 12, 1900.—SHARPE, Proc. U. S. Nat. Mus., vol. 38, p. 406, 1911.

Occurrence.—A few specimens were obtained in the surface net over a depth of 118 and 67 fathoms, and in the bottom net towed at a depth of 40 fathoms during the trip to the 100-fathom line. It was not found anywhere within the limits of the bay.

Remarks.—The species was established by Wheeler upon numerous specimens of both sexes, which he considered identical with the ones described by Brady under the name *Centropages violaceus* (Claus).⁴ This identification appears indisputable, and the range of the species on our American shores is here extended southward to Chesapeake Bay.

CENTROPAGES HAMATUS (Lilljeborg)

Ichthyophorba hamata LILLJEBORG, De Crustaceis ex ordinibus tribus in Scania occurrentibus, p. 185, pl. 21, figs. 9–12, 1853.

Centropages hamatus G. O. SARS, Crustacea of Norway, vol. 4, p. 76, pl. 52, 1902.

Occurrence.—Universally distributed throughout the bay and found at every station except U and Z. Appearing most abundant during winter in the outer bay and during spring in the inner bay. Taken indiscriminately in surface, bottom, and vertical nets, and present also in the outside ocean.

Remarks.—This species was given by Fish as one of the three typical winter forms at Woods Hole, and he added that the development

⁴ Report on the *Challenger* Expedition, vol. 8, pt. 23, Copepoda, p. 83, pl. 27, 1883.

stages became so abundant in January and February as to far outnumber the adults. Probably some of the development stages noted during the present survey at various stations in the outer bay during winter belonged to this species. Found by Sars both in the Norwegian fiords and in the open ocean and believed to form an essential part of the food of several pelagic fishes, such as the herring and the mackerel. In Chesapeake Bay it is probably eaten also by the shad during their spring migrations.

CENTROPAGES TYPICUS Krøyer

Centropages typicus KRØYER, Naturh. Tidsskrift, vol. 2 (new ser.), p. 588, p. 6, figs. 22-26, 1847.—G. O. SARS, Crustacea of Norway, vol. 4, p. 75, pls. 49-51, 1902.

Occurrence.—Universally distributed throughout the bay and found at nearly every station. It is essentially a winter species but is probably present during the entire year. Like *C. hamatus* it was taken in surface, bottom, and vertical nets and was present in large numbers in the outside ocean.

Remarks.—Given by Fish as one of the two pelagic species that together form the bulk of the summer copepod fauna at Woods Hole. In Chesapeake Bay it is just as typically a winter form, but is apparently a summer species in the ocean outside the bay. Found in both the open sea and the fiords of the Norwegian coast, often in great abundance. Brady said that this species and *C. hamatus* were so common in the North Sea and the Atlantic that few gatherings were without them.

EUCHAETA NORVEGICA Boeck

Euchaeta norvegica BOECK, Christiania Videnskabeliger Selskabet Forhandling, p. 40, 1872.—G. O. SARS, Crustacea of Norway, vol. 4, p. 38; pls. 24-26, 1902.

Occurrence.—A few females of this species were taken in the bottom net on the 100-fathom line in the outside ocean, but it was not found anywhere within the bay.

Remarks.—This is a northern pelagic species and according to Bigelow occurs in most horizontal hauls deeper than 100 meters, but only sporadically at higher levels. Probably the present record is as far south as it has been obtained, and as it is an inhabitant of deep water there is little likelihood that it will be found within the bay. Sars found it particularly in the great depths of the fiords, and probably one condition that keeps it from entering the bay is the shallowness of the water. It is also possible that this copepod can not accommodate itself as readily as some others to any considerable change in salinity.

EURYTEMORA AMERICANA Williams

Eurytemora americana WILLIAMS, Amer. Nat., vol. 40, p. 645, figs. 8-11, 1906.

Occurrence.—Found at two stations at the mouth of the bay and at six stations in the inner bay, but not taken in the outside ocean. Not an abundant species and confined to winter and early in spring.

Remarks.—Not recorded by any author since Williams, 1906. In the present survey only a few specimens were obtained at the mouth of the bay, but about 150 were taken in each of two hauls with a bottom net in the inner bay, in 9 or 10 meters of water over a muddy bottom. Two other species of this genus were mentioned by Professor Willey as important factors of the stomach contents of shad caught in Nova Scotia waters. If the shad there consume the local species of *Eurytemora*, there is no reason why they should not do the same in Chesapeake Bay.

EURYTEMORA HIRUNDOIDES (Nordquist)

Temorella affinis var. *hirundoides* NORDQUIST, Die Calaniden Finlands, p. 48, pl. 4, figs. 5-11, pl. 5, fig. 5, 1888.

Eurytemora hirundoides G. O. SARS, Crustacea of Norway, vol. 4, p. 102, pl. 69, 1902.

Occurrence.—Widely distributed in the inner bay, but only sparingly in the outer bay; found most abundant at Station Z in water 13 meters deep on a muddy bottom. In three hauls made on March 27, 1921, it formed 25 per cent of the surface net total, 20 per cent of the vertical net total, and 15 per cent of the bottom net total estimated at 100,000 specimens.

Remarks.—This is a brackish-water species, which explains why it is so much more numerous in the inner bay. Its abundance there makes it one of the most important constituents of the plankton.

LABIDOCERA AESTIVA Wheeler

Labidocera aestiva WHEELER, Bull. U. S. Bur. Fisheries, vol. 19, p. 178, fig. 16, 1900.

Occurrence.—Distributed universally in the outer bay, sparsely in the inner bay, captured usually in the bottom net, but taken also at the surface. Most abundant in autumn, especially in the inner bay, but present also in summer and winter in the outer bay and at the surface of the outside ocean during summer.

Remarks.—This copepod was recorded by both Wheeler and Fish as a summer form at Woods Hole, whence its specific name. In Chesapeake Bay it is just as distinctly a winter and autumn species. It was found in sufficient numbers in the outer bay to constitute an important factor of the plankton, but in the inner bay it occurred so sparingly that it was seldom credited with a percentage mark.

LABIDOCERA WOLLASTONI (Lubbock)

Pontella wollastoni LUBBOCK, Ann. Mag. Nat. Hist., ser. 2, vol. 20, p. 406, pls. 10, 11, 1857.

Labidocera wollastoni G. O. SARS, Crustacea of Norway, vol. 4, p. 142, pls. 95, 96, 1902.

Occurrence.—Ten specimens of this species, including both sexes, were obtained in a surface net at Station G, August 22, 1920.

Remarks.—The single occurrence and limited number of this species make it a rare copepod in the plankton of the bay and of no economic value. It has never before, however, been reported from our American coast, as all Giesbrecht's specimens came from the western Atlantic. Sars considered it "like all the other Pontellidae, a true pelagic form, occurring more generally in the open ocean, close to the surface of the sea" (p. 143).

MECYNOCERA CLAUSII I. C. Thompson

Mecynocera clausii THOMPSON, Journ. Linnaean Soc. London, vol. 20, p. 146, pl. 11, figs. 1-4, 1888.—WHEELER, Bull. U. S. Bur. Fisheries, vol. 19, p. 163, fig. 5, 1899.

Occurrence.—About 150 specimens of this species were obtained in the bottom net at the 100-fathom line outside the bay.

Remarks.—This is another distinctly pelagic copepod and southern in its habitat. It is very transparent and colorless and is hence easily overlooked unless carefully searched for. The exceptionally long first antennae are very buoyant, and, when stretched out at right angles to the body axis, they hold the copepod in suspension, sometimes even after preservation. It is not likely to be found inside the limits of the bay. T. Scott⁵ reported this copepod from 16 of the tow-net gatherings, the deepest of which came from a depth of 235 fathoms.

METRIDIA LUCENS Boeck

Metridia lucens BOECK, Christiania Videnskabelige Selskabet Forhandling, p. 238, 1864.—G. O. SARS, Crustacea of Norway, vol. 4, p. 113, pl. 77, 1902.

Occurrence.—Taken in large numbers in the bottom net during the trip to the 100-fathom line at depths of 40 and 118 fathoms.

Remarks.—Wheeler secured but a single specimen at Woods Hole in summer, but Fish found it a very common form in winter and spring. If it comes into the harbor at Woods Hole so freely at that season of the year, it would seem possible at least that it may enter the outer portion of Chesapeake Bay during the same season. This species is luminous and gives off a brilliant blue-green light when disturbed. During the spring before the summer plankton has

⁵ Report on Entomostraca from the Gulf of Guinea, collected by John Rattray, B. Sc., Trans. Linn. Soc. London, ser. 2, vol. 6, pt. 1, Zoology, 161 pp., 15 pls., 1894.

developed, this copepod is one of the chief causes of marine phosphorescence. It was reported by Farran as forming with *Calanus finmarchicus* the main bulk of the tow on the Irish fishing grounds during spring and early summer, and as constituting an important factor in the food of the mackerel.

PARACALANUS PARVUS (Claus)

Calanus parvus CLAUS, Die frei lebenden Copepoden, p. 173, pl. 26, figs. 10-14; pl. 27, figs. 1-4, 1863.

Paracalanus parvus G. O. SARS, Crustacea of Norway, vol. 4, p. 17, pls. 8, 9, 1901.

Occurrence.—Found at every station in the bay except T and U, usually in considerable abundance in the outer bay, but gradually diminishing in numbers toward the inner end of the bay. Taken indiscriminately in surface, bottom, and vertical nets. Most abundant during autumn in the outer bay and during winter in the inner bay, but present everywhere throughout the year. Also found in large numbers in every haul but one during the trip to the 100-fathom line in the outside ocean.

Remarks.—Wheeler's record was the first for our American shores, and the present one carries the species as far south as the Chesapeake.

PONTELLA ATLANTICA (Milne-Edwards)

Pontia atlantica MILNE-EDWARDS, Histoire naturelle des Crustacés, vol. 3, p. 420, pl. 37, figs. 4-17, 1840.

Pontella atlantica, GIESBRECHT, Fauna und Flora des Golfes von Neapel, vol. 19, p. 461, pl. 24, figs. 1, 3, 13, 45, 49, 50; pl. 40, figs. 5, 8, 12, 13, 33, 41, 42, 1892.

Occurrence.—A few specimens of this species were taken in the bottom net at the 100-fathom line outside the bay.

Remarks.—This is another pelagic form and is not likely to be found within the limits of the bay. Although reported by many authors from the Atlantic Ocean, the localities given are all eastern, and it has not hitherto been found upon our American shores. It is the largest species of the genus and was given the specific name *magna* by Lubbock in 1853, and *gigantea* by Claus in 1863, both of which become synonyms of Milne-Edwards's name, given in 1840. Now that it has been found on this side of the Atlantic, this last name becomes even more appropriate. In spite of its size it has never been found in sufficient numbers to become of economic importance.

PONTELLA MEADII Wheeler

Pontella meadii WHEELER, Bull. U. S. Bur. Fisheries, vol. 19, p. 180, fig. 17, 1900.

Occurrence.—Numerous specimens of both sexes were taken in the surface and vertical nets at Station F, August 22, 1920, and in the bottom net October 21. A few others were obtained at Stations

A, O, and Q in surface and bottom nets; it was also present at the surface on the 100-fathom line.

Remarks.—Wheeler obtained only a few specimens in July and implied that they had been blown in from the southeast during a storm. Fish also recorded it as a summer form from the Gulf Stream. Its presence on the 100-fathom line at the latitude of Chesapeake Bay indicates that it is a southern form that occasionally gets as far north as Woods Hole. It has not thus far been found in the Gulf of Maine. It was found only in the outer portion of Chesapeake Bay during summer.

PONTELLA PENNATA, new species

PLATE 1

General characters.—This species closely resembles *P. meadii*, but the female can be readily distinguished from any other species of the genus, as well as from all free-swimming copepods, by the long pennon, or streamer, borne upon the last segment of the thorax, by the excessively short, 1-segmented abdomen, and by the minute non-plumose setae upon the caudal rami. The male is characterized by a long fingerlike process armed with spines and borne upon the anterior margin of the seventeenth* segment of the grasping antenna.

Specific characters of female.—Groove between head and first thoracic segment distinct; fourth and fifth thoracic segments separated, fourth segment with a rounded projection overlapping the fifth segment on the dorsal surface at the midline; fifth segment prolonged on each side into a broad and rather blunt point, nearly symmetrical. In addition to these usual lateral points this last segment has also two chitinous outgrowths. One of these is a thin lamella standing on edge along the midline on the dorsal surface just behind the projection from the fourth segment. It is crescent-shaped with the concave side toward the segment, the anterior point extending above the surface nearly to the posterior margin of the third segment. The posterior point is shorter but extends backward above the surface of the abdomen to the posterior margin of the latter. Being thus located on the midline and standing vertically, it is still symmetrical. The second outgrowth, however, is completely asymmetrical, being attached to the dorsolateral surface of the fifth segment, on the right side only and close to the lateral margin. It is also a thin lamina, which extends forward above the surface of the fourth and third segments nearly to the posterior margin of the second segment. It divides opposite the groove between the third and fourth segments into two parts. The portion nearest the body is short and

* According to Giesbrecht's numbering; in fig. D it is apparently on the twelfth segment.

rounded and curves inward toward the midline. The outer portion folds abruptly over dorsally and curves backward in a long pennon, or streamer, approximately parallel to the body axis, and nearly as long as the copepod itself. This streamer tapers gradually to a narrow point, and its edges are frayed into jagged teeth and fingerlike processes. These chitinous outgrowths make this species unique, although they are foreshadowed in a way by the asymmetrical processes in other species.

The antennae and mouth parts are similar to those of other species of the genus, with certain variations. Chief among the latter are the differences found in the chewing blade of the mandible. The drawing of this (pl. 1, G) shows that it is peculiarly powerful and armed with a row of formidable teeth. If its structure is any indication of habits this species must be very predacious, living upon all sorts of smaller creatures in the plankton. Its large size and its strong maxillae and maxillipeds enable it to seize and overpower these animals, which can then be chewed up by the mandibles. The fifth legs are much reduced in size and appear stunted when compared with those of *P. meadii*. The endopods are more than half the length of the exopods and end in two stout spines of approximately the same length.

Specific characters of male.—The male is slightly smaller than the female (A and C of Plate 1 are drawn to different scales). Its body is relatively thicker and its abdomen much longer, although still below the average for *Pontella* males. The lobes at the posterior corners of the last thoracic segment are distinctly asymmetrical, the right one being considerably longer and more sharply pointed. The abdomen, however, is practically symmetrical, but the last two joints are telescoped into the preceding joint so far as to be almost indistinguishable.

The right, or grasping, antenna is characterized by a long and stout fingerlike process projecting from the anterior margin of the seventeenth segment. This is armed along its outer margin with a row of four stout spines, which will at once distinguish this species from *meadii*, or indeed from any other species of the genus. One or two other species have such a process, but it is not armed with spines and is attached to a different segment. There is also a long and slender seta, or spine, on the fused thirteenth-fourteenth segment, similar to that in other species, but longer and hooked at the tip.

The second antennae and mouth parts are of the usual form; the fifth legs are very similar to those of the preceding species, but relatively much stouter, and the nonchelate ramus is considerably longer and armed with extra spines.

Color.—Somewhat like *meadii*, with a mid-dorsal row of dark spots, which are brown rather than black. In formalin specimens, the thickened portion of the grasping antenna of the male is a deep blue, almost purple. No blue or bluish-green markings appear anywhere else upon the body or appendages.

Measurements.—*Female*: Total length, 3 mm. to 3.5 mm.; greatest width at posterior margin of head, 1 mm.; length of posterior body, 0.125 mm. *Male*: Total length, 2.85 mm. to 3.25 mm.; greatest width at posterior margin of first thoracic segment, 1.1 mm.; length of posterior body, 0.5 mm.

Occurrence.—Several females were taken in a surface net on August 22, 1920, and in a bottom net on October 20, both at Station C. A few specimens were also captured at the surface on the 100-fathom line.

Types.—U.S.N.M. No. 58568, male, holotype; No. 63416, female, paratype.

Distribution.—Woods Hole (Fish).

Remarks.—Though this is probably a pelagic species, it comes into Woods Hole in considerable numbers during summer. It was obtained there in the tow during the summer of 1923, associated with *meadii*. It evidently enters Chesapeake Bay in a similar manner, since Station C is at least 20 miles inside the mouth of the bay, and there is no reason why it should not be found elsewhere in the outer bay. At first sight it might be supposed that the long chitinous streamer would hinder the activity of the female as compared with that of the male, or even with other copepods not thus burdened. But we do not find this to be true; the movements of the female are fully as energetic, and the resultant locomotion is as graceful and agile as if the body were without these chitinous outgrowths. It is very difficult to think of any way in which such outgrowths could be useful or protective to the copepod that bears them.

PSEUDOCALANUS ELONGATUS (Boeck)

Clausia elongata BOECK, Christiania Videnskabeliger Selskabet Forhandler, p. 234, 1864.

Pseudocalanus elongatus G. O. SÆRS, Crustacea of Norway, vol. 4, p. 20, pls. 10, 11, 1901.

Occurrence.—Universally distributed, but did not appear at 12 of the stations, 7 of which were in the inner bay. Taken oftener at the surface, but present sometimes in the bottom and vertical nets. A winter form in the outer bay and a spring form in the inner bay; present also in the ocean outside the bay.

Remarks.—Sars's statement that the most southern place where this species has been observed was the northern coast of France, latitude 48° N., must now be extended to 37° N. Fish found the young

of this species so abundant in January and February at Woods Hole that they far outnumbered the adults, showing that they breed freely there in winter. This species ranks next to *Calanus finmarchicus* in abundance in the Gulf of Maine. It is very much less abundant in Chesapeake Bay, and its percentage mark only rarely gets above 5, and is frequently less than 1. This is what would naturally be expected of a northern form when found so far south. In a plankton series collected continuously across the North Atlantic by Herdman, this species was very common around both shores and was also taken in mid-ocean.

PSEUDODIAPTOMUS CORONATUS Williams

PLATE 2

Pseudodiaptomus coronatus WILLIAMS, Amer. Nat., vol. 40, p. 641, figs. 1-7, 1906.—SHARPE, Proc. U. S. Nat. Mus., vol. 38, p. 412, fig. 4, 1911.

General characters.—Abdomen of male with four segments, of female with three segments; genital segment of female swollen, asymmetrical, and covered with irregular patches of spines. Fifth legs of female with four segments and a stout terminal spine; fifth legs of male as shown in Plate 2, J.

Specific characters of female.—Body slender, anterior portion elliptical, two and a half times as long as wide; head separated from first thoracic segment and evenly rounded anteriorly. Posterior body quite asymmetrical, the left side more fully developed than the right. Genital segment much swollen, with numerous irregular patches of spines and bristles and a pair of long pointed flaps extending behind the genital orifice. Abdomen of three segments, the two basal ones irregular, the terminal one more symmetrical. Left caudal ramus considerably longer than the right and curved outwards, six and a half times as long as wide; right ramus straight and only five and a half times as long as wide.

The plumose setae at the tips of the rami are each jointed near the center and swollen in front of and behind the joint. The same is true of the setae of the swimming legs, as was shown by Williams, but neither he nor Sharpe mentioned the jointing in the caudal setae.

Every female with egg sacks carried a large left sack, containing about 25 eggs, and a minute right sack containing only two eggs. But Sharpe found one or two females at Woods Hole with egg sacks about equal in size, and a single female that carried one large sack.

First antennae 20 to 22 jointed, the jointing so indistinct as to be practically invisible in places; when reflexed the first antennae do not quite reach the posterior margin of the front body. Second antennae with an outer ramus much longer than the inner one and 3-segmented, the basal segment much shorter than either of the other two, the terminal segment ending in three very long plumose setae.

The inner ramus also ends in three long setae, with a tuft of five others on the inner margin near the tip of the terminal joint.

Chewing blade of the mandible broad and stout, with very irregular margins; teeth small, blunt, and all about the same size except the one at the inner corner, which is long, slender, sharply pointed, and pectinate. Outer ramus of palp 4-segmented, inner ramus 2-segmented, its terminal joint turned at right angles and ending in eight setae, all about the same size and length. First maxillae broadly laminate, with flattened and laminate setae; second maxillae 5-segmented, the setae of the four basal segments mounted on long papillae. Maxillipeds with stout basal joints and a 4-segmented ramus. First four pairs of swimming legs with 3-jointed rami; spines of the exopods with serrated margins; fifth legs uniramous, 4-segmented, each leg tipped with a pectinated spine much longer than the terminal joint.

Specific characters of male.—Like the female but with the posterior body symmetrical; abdomen with four segments when fully matured, in other respects like the young male figured in Plate 2; caudal rami three to three and a half times as long as wide and without marginal hairs. Right fifth leg uniramous, 4-segmented, with a terminal claw much like that in the female; left leg biramous, basipod and exopod 2-segmented, endopod with a single bladelike segment, toothed along its curved outer margin near the tip and at the center. First segment of basipod with fingerlike processes on its inner margin, second joint with coarse hairs on its inner margin; exopod tipped with three or four small spines.

Measurements.—Length: Female, 1.5 mm.; male, 1.2 mm.

Occurrence.—Taken at every station in the bay except J, L, and U; never in any abundance but often with a percentage of less than 1. Definitely a winter form but sometimes present at other seasons; usually taken at or near the bottom in the bay but found only at the surface in the outside ocean.

Distribution.—Nova Scotia (Willey); Narragansett Bay (Williams); Sheepshead Bay, N. Y. (Sharpe); Woods Hole (Sharpe, Fish).

Remarks.—Williams and Sharpe obtained their specimens in summer, except those from Sheepshead Bay, which were taken in September. Fish said it was not a true summer species at Woods Hole, but reached its maximum in fall, when it outnumbered all other copepods. In Chesapeake Bay the maximum seems to be reached still later in fall or early in winter, but even then the percentage rarely gets above 5, all such instances being near the inner end of the bay. The second antennae and mouth parts, with minor details of the rest of the body, are figured in Plate 2 to supplement the account here given.

RHINCALANUS NASUTUS Giesbrecht

Rhincalanus nasutus GIESBRECHT, Fauna und Flora des Golfes von Neapel, vol. 19, p. 154, pl. 3, fig. 6; pl. 9, figs. 6, 14; pl. 12, figs. 9-12, 14, 16, 17; pl. 35, figs. 46, 47, 49, 1892.—G. O. SARS, Crustacea of Norway, vol. 4, p. 15, pls. 6, 7, 1901.

Occurrence.—A few females were taken in the bottom net at the 100-fathom line outside the bay.

Remarks.—This is a distinctive pelagic copepod and is not likely to be found within the bay. Farran⁷ said of this species: "As far as concerns its distribution in the greater part of the Atlantic, it may be regarded as an inhabitant of the Atlantic current, its distribution to the north and east depending on the varying strength of that stream."

TEMORA DISCAUDATA Giesbrecht

Temora discaudata GIESBRECHT, Atti Accademei Lincei, Rome, ser. 4, vol. 5, p. 814, 1889; Fauna und Flora des Golfes von Neapel, vol. 19, p. 328, pl. 17, figs. 3, 20, 23; pl. 38, figs. 24, 25, 28; 1892.

Occurrence.—A few specimens were obtained in the surface net at Station C, October 20, 1920, and in the bottom net at Station F on October 21. At neither place did the catch include a sufficient number to be worthy of a percentage mark.

Remarks.—This species has not been hitherto reported from the North Atlantic, but is easily recognized by the sharp projections at the posterior corners of the fourth thoracic segment, the asymmetrical furca of the female, and the peculiar fifth legs of the male. It did not occur in sufficient abundance to become of any economic importance as a constituent of the plankton.

TEMORA LONGICORNIS (Müller)

Cyclops longicornis O. F. MÜLLER, Entomostraca seu insecta testacea, p. 115, 1792.

Temora longicornis G. O. SARS, Crustacea of Norway, vol. 4, p. 97, pls. 65, 66, 1902.

Occurrence.—Taken in small numbers in bottom and vertical nets at Stations E, F, and G at the mouth of the bay, and in the vertical net at Station Y. It was also present at the surface in the outside ocean.

Remarks.—Williams found this species all through the year in Narragansett Bay, but Fish listed it as one of the three typical winter forms at Woods Hole. It apparently occurs only in winter in Chesapeake Bay and even then in small numbers. Its presence at both ends of the bay indicates that it may be found at times anywhere in the bay.

⁷ Bulletin Trimestriel, pt. 1, p. 65, 1910.

TEMORA TURBINATA (Dana)

Calanus turbinatus DANA, Wilkes Expedition, Crustacea, vol. 14, p. 1057, 1853.
Temora turbinata GIESBRECHT, Fauna und Flora des Golfes von Neapel, vol. 19,
p. 329, pl. 17, figs. 14, 17, 18, 21; pl. 38, fig. 27; 1892.

Occurrence.—Found only during autumn and winter in the outer bay at stations near the mouth. Taken at the bottom, at the surface, and in the vertical net in consecutive hauls at one station. A single surface haul at Station F, December 4, 1920, yielded 1,000 specimens of this species.

Remarks.—This species has not hitherto been reported from our American shores. It can be distinguished from *longicornis* most readily by the short anal segment and the details of the fifth legs. Although it was not found at all in the inner bay, it was present in the outer bay in numbers sufficiently large to give it considerable economic importance. In all probability it furnishes an important constituent in the food of the shad when they come to the bay in their spring migration.

Suborder HARPACTICOIDA

ALTEUTHA DEPRESSA Baird

Alteutha depressa BAIRD, British Entomotraca, p. 216, pl. 30, figs. 1, 2, 1850.—
G. O. SARS, Crustacea of Norway, vol. 5, p. 64, pl. 38, 1904.

Occurrence.—Taken at Station F over a sandy bottom in 16 meters of water, at Station G' over a bottom of mixed sand, gravel, and mud in 28 meters of water, and also in surface and vertical nets; found only during December and January. Not enough specimens were obtained in any one haul to equal even 1 per cent of the total.

Remarks.—This littoral harpacticid was found in such small numbers and was so restricted in its distribution at the very mouth of the bay that it must be regarded as a straggler from the outside ocean.

CANUELLA ELONGATA, new species

PLATE 3, A-H

General characters.—Body of nearly the same width throughout, slightly narrowed posteriorly, with deep grooves between the segments. Abdomen with three segments; caudal rami twice the length of the last segment, inclined at an angle of 45° with the body axis, each tipped with four setae.

Specific characters of female.—Head small and a little wider than the first segment, from which it is distinctly separated. Lateral areas slightly and rather squarely expanded; rostral plate broad and rounded at the tip. First thoracic segment well defined, but much shorter than the others, succeeding segments about the same length and width. Genital segment slightly narrower than the fifth

segment, a little longer than wide, with a transverse dorsal suture nearly at the center. The two basal segments of the abdomen nearly the same length and width, the terminal segment about as wide as the others but much shorter. Caudal rami tapered so that the tips are about half the width of the bases. Of the four terminal setae on each ramus the two outside ones are short, the two between them longer, the inner of these two twice as long as the outer. Both the upper and the under surfaces of these rami are covered with short hairs.

The first antennae are stout, 5-segmented, and armed with coarsely plumose setae. The exopod of the second antennae is as long as the endopod and 7-segmented, and both rami are armed with stout setae. The chewing blade of the mandible is stout and widened considerably at the tip, which is armed with five coarse and rather blunt teeth on the inner side, and a bunch of four or five slender and very sharp ones at the outer corner. Maxillae and maxilliped similar to those in other species of the genus, with minor differences.

First legs shorter than the other pairs; spines on the exopod long, stout, and pectinate; endopod much longer than the exopod but not so wide; spine just inside the base of the endopod nearly as long as the two basal joints of the latter and smooth. Fourth legs slender, the endopod much longer than the exopod, with small and comparatively weak spines at the inner distal corners of the first two joints; no spine on the outer margin of the terminal joint of the exopod and no seta on the inner margin of the second joint. Fifth leg a minute lamina, tipped with four tiny setae. Egg sacs large and elongate-oval in form.

Color (preserved material).—A light brownish yellow.

Measurements.—Total length, including furcal rami, 1.65 mm.; width of head, 0.3 mm.

Occurrence.—Seven females, two of which carried egg sacs, were obtained in the bottom net at Station W on June 3, 1921, drawn from a depth of 13 meters over a muddy bottom. The male is unknown.

Types.—U.S.N.M. No. 58571, holotype; No. 63417, paratypes.

Remarks.—T. Scott established this genus for a species obtained in the Firth of Forth. G. O. Sars found the same species on the Norwegian coast and also a new species in the upper part of Christiania Fiord. The present species differs from these two in the length of the abdomen, in the width and bluntness of the rostral plate, and in the details of the mandibles and the first and fourth swimming legs. Like the other species it was found in shallow water over a muddy bottom. It does not occur in sufficient abundance to render it of any economic importance in the life of the bay.

CLETODES LONGICAUDATUS (Boeck)

Enhydrosoma longicaudata BOECK, Christiania Videnskabeliger Selskabet Forhandler, p. 54, 1872.

Cletodes longicaudatus G. O. SARS, Crustacea of Norway, vol. 5, p. 286, pl. 197, 1909.

Occurrence.—About 20 specimens of this copepod were taken in a bottom net at Station R on December 8, 1920, drawn from a depth of 47.5 meters over a bottom of mixed mud and sand. This was the only appearance of the species during the entire survey.

Remarks.—The copepod first described by Brady and Robertson in 1875 and afterward by Brady alone in his British Copepoda as *Cletodes longicaudatus* is not identical with the present species, and possibly, as Sars suggests, does not even belong to the same genus. So far as known the species has not before been reported from our American coast.

CLYTEMNESTRA ROSTRATA (Brady)

Goniopsyllus rostratus BRADY, Challenger Copepoda, p. 107, pl. 42, figs. 9-16, 1883.

Clytemnestra rostrata GIESBRECHT, Fauna und Flora des Golfes von Neapel, vol. 19, pp. 566, 572, pl. 45, figs. 19, 20, 22, 25, 26, 31, 33, 1892.

Occurrence.—Obtained only at the surface in the ocean outside the bay, where the depths were 118 and 67 fathoms. The combined catches consisted of only a few specimens, including both sexes.

Remarks.—This copepod nowhere occurs in any abundance; Brady obtained but a single specimen, and Esterly reported one female in summer, but added "occurs also in winter" without specifying the number. Brian and Giesbrecht recorded it as rare in the Mediterranean, and it apparently never becomes numerous enough to possess economic value. It is a pelagic copepod and is not likely to be found within the limits of the bay.

DACTYLOPUSIA BREVICORNIS (Claus)

Dactylopus brevicornis CLAUS, Die Copepodenfauna von Nizza, p. 29, pl. 3, figs. 20-25, 1866.

Dactylopusia brevicornis G. O. SARS, Crustacea of Norway, vol. 5, p. 130, pl. 80, 1905.

Occurrence.—Two specimens of this species were obtained at Station N' in a surface net on December 7, 1920, and were the only ones found during the survey.

Remarks.—This tiny harpacticid is manifestly a rare species in the bay. Two other species of the genus, more cosmopolitan in their distribution, were obtained by Sharpe at Woods Hole, but the present one has not been hitherto reported from our American shores. It is abundant in the Mediterranean, and Brian has given a

detailed description of five copepodid stages in its life history. It is a littoral form and is easily distinguished from the other species of the genus.

DIOSACCUS TENUICORNIS (Claus)

Dactylopus tenuicornis CLAUS, Die frei lebenden Copepoden, p. 127, pl. 16, figs. 17-23, 1863.

Diosaccus tenuicornis G. O. SARS, Crustacea of Norway, vol. 5, p. 146, pls. 89, 90, 1906.

Occurrence.—A single female was taken in the vertical net at Station F on December 4, 1920, in water 16 meters deep over a muddy bottom. This was the only specimen obtained during the survey.

Remarks.—Sars said that this species was abundant along the whole Norwegian coast in the littoral zone among the algae. It is probable, therefore, that it occurs in Chesapeake Bay in greater abundance than this single capture indicates. It is not likely, however, to become of economic importance in the plankton of the bay.

ECTINOSOMA CURTICORNE Boeck

Ectinosoma curticorne BOECK, Christiania Vidensk. Selskabet Forhandlinger, p. 45, 1872.—G. O. SARS, Crustacea of Norway, vol. 5, p. 36, pl. 20, 1904.

Occurrence.—Well distributed, more particularly in the inner bay, where it was found at a majority of the stations. Taken usually in the bottom net in the outer bay, but often at the surface in the inner bay. A winter species but lasting into spring and sometimes into summer. The largest single haul was in a vertical net at Station Z on March 27, 1921, in 13 meters of water over a muddy bottom, when about 700 specimens were obtained.

Remarks.—This little copepod is found in sufficient numbers in the inner bay to form an important constituent of the plankton. It is evidently a littoral species and lives in brackish water.

ECTINOSOMA NORMANI T. and A. Scott

Ectinosoma normani T. and A. SCOTT, Trans. Linnaean Soc. London, vol. 6, p. 435, pl. 36, figs. 21, 29, 39; pl. 37, figs. 12, 26, 34, 51; pl. 38, figs. 5, 18, 42, 45; 1897.—G. O. SARS, Crustacea of Norway, vol. 5, p. 35, pl. 19, 1904.

Occurrence.—About 30 specimens of this species, all females, were taken in the bottom net at Station Y, January 27, 1921, from water 20 meters deep over a muddy bottom; this is the only record for the bay.

Remarks.—This species is much less common than *E. curticorne* and probably occurs but rarely in the bay. Like the other species of the genus it is a littoral form and lives in the shallower and less saline water. The bright-red pigment patch on each side of the head between the bases of the first and second antennae forms a

striking character, and the color remains in some of the preserved specimens. This furnishes a quick method of distinguishing the species from others of the genus, and the distinction can afterward be verified by an examination of the fifth legs.

HARPACTICUS CHELIFER (O. F. Müller)

Cyclops chelifer O. F. MÜLLER, Zoologicus Danaae Prodromus, p. 2913, 1776; Entomostraca, p. 114, pl. 13, figs. 1-3, 1785.

Harpacticus chelifer G. O. SARS, Crustacea of Norway, vol. 5, p. 49, pls. 27, 28, 1904.

Occurrence.—Only two females of this species were taken, at Station G in a surface net December 4, 1920.

Remarks.—This is a northern form, littoral in habit, and hence is likely to occur in any numbers in the bay. It can be recognized at once by the enormous chelae on the maxillipeds, which are much larger than those of other species of the genus. Sars recorded it as found in "quite shallow water close to the shore among algae, and not infrequently left in tidal pools together with other littoral species." From the distribution given by various authors this is an extremely cosmopolitan species, appearing in nearly every sea and ocean.

HARPACTICUS GRACILIS Claus

Harpacticus gracilis CLAUS, Die frei lebenden Copepoden, p. 135, pl. 19, fig. 20, 1863.—G. O. SARS, Crustacea of Norway, vol. 5, p. 52, pl. 30, 1904.

Occurrence.—Widely distributed throughout the bay but more abundant in the inner portion. Taken most frequently at the surface and in the winter, but lasting into spring and sometimes into summer. Nowhere found in sufficient numbers to constitute more than 1 or 2 per cent of the total haul, and usually much less than that.

Remarks.—In spite of the wide distribution of this copepod throughout the bay, the small numbers found at each station prevent it from becoming of much importance in the economy of the plankton. It does help, however, by its continued presence through most of the year, and contributes its quota toward the food supply. It is a littoral form and was reported by both Sars and Brian as found in comparatively shallow water among algae. As far as known it has not before been reported from our American coasts.

HARPACTICUS LITTORALIS G. O. Sars

Harpacticus chelifer BRADY, British Copepoda, vol. 2, p. 146, pl. 64, figs. 19-20; pl. 65, figs. 1-15, 1880.

Harpacticus littoralis G. O. SARS, Crustacea of Norway, vol. 5, 363, suppl. pl. 8, 1910.

Occurrence.—About 40 specimens of this species were obtained in a surface net at Station R' on December 8, 1920, and a few stragglers were also taken at Stations S and T.

Remarks.—Sars said of this copepod: "It is a pronouncedly littoral species, being generally found in very shallow water, especially in flat sandy creeks." R' and T were two of the shallowest stations in the bay, the water measuring 7 and 9 meters, respectively, but S was considerably deeper. In all three, however, the water was decidedly brackish, especially at the surface, where these specimens were obtained. In general, therefore, the conditions here in Chesapeake Bay correspond favorably with those given by Sars.

MACROSETELLA GRACILIS (Dana)

Setella gracilis DANA, Wilkes Expedition, Crustacea, vol. 14, p. 1198, pl. 84, fig. 3, a-g, 1853.—WHEELER, Bull. U. S. Bur. Fisheries, vol. 19, p. 188, fig. 24, 1900.

Occurrence.—Nearly 100 specimens of this species were taken in a surface net over a depth of 67 fathoms in the outside ocean; none were found within the limits of the bay.

Remarks.—This copepod can be recognized at once by its linear body and excessively long caudal setae. It is a true pelagic form and is not likely to be found anywhere in the bay.

MICROSETELLA NORVEGICA (Boeck)

Setella norvegica BOECK, Christiania Videnskebeliger Selskabet Forhandlinger, pl. 11, fig. 1 (9 figs.), 1864.

Microsetella norvegica G. O. SARS, Crustacea of Norway, vol. 5, p. 44, pl. 24, 1904.

Occurrence.—About 100 specimens, including both sexes, were obtained in a vertical net at Station F on December 4, 1920, and 70 more in a surface net at Station E on January 22, 1921.

Remarks.—From the distribution given by various authors this is a very cosmopolitan species. According to Sars it is a true pelagic copepod, always taken near the surface and usually at a considerable distance from shore. Although it did not appear during the August trip to the 100-fathom line, it is probably present there in winter and early in spring, the season at which it was found at the mouth of the bay.

MICROTHALESTRIS LITTORALIS G. O. Sars

Microthalestris littoralis G. O. SARS, Crustacea of Norway, vol. 5, p. 369, suppl. pl. 11, fig. 1 (9 figs.), 1911.

Occurrence.—This species was widely distributed throughout the entire bay, but was nowhere abundant. The largest haul was at Station T in a bottom net on March 29, 1921, from water 9 meters deep over a muddy bottom. Here it constituted 1 per cent of a catch that totaled 25,000, but its numbers were usually so small as to fall below a percentage mark.

Remarks.—Sars called this harpactid “a pronouncedly littoral form, being only found in the uppermost part of the littoral zone, and very often in shallow pools left by the tide.” In Chesapeake Bay it was almost wholly confined to winter and early spring. Being a new species established by Sars and afterward found by Steur, Pesta, and Brian in the Mediterranean, it has never before been reported from our American coast. Sars found only the female, but Brian added the male of the species, and the present specimens included also both sexes.

ROBERTSONIA CHESAPEAKENSIS, new species

PLATE 4, A-I

Specific characters of female.—Body fairly stout, almost cylindrical; anterior portion considerably dilated, a little more than half as wide as long, widest in the center. Cephalic segment nearly equaling in length the entire thorax, widest across its posterior margin. Rostrum narrow-triangular, longer than wide and bluntly pointed. Second, third, and fourth thoracic segments smoothly rounded at their posterior corners. Posterior body three-quarters as long and a little more than half as wide as the anterior. Genital segment as long as the entire abdomen, with a transverse suture near the center, which is distinct on the sides and ventral surface but fades out on the dorsal surface. Abdomen of three segments, diminishing in length posteriorly; anal segment with an angular notch between the bases of the caudal rami; the latter wider than long, obtusely truncated and tipped with two long and several shorter setae. Eye small but fairly distinct. Egg case single.

Specific characters of male.—Body regions similar to those of the female, posterior body rather stouter; its segments fringed on their posterior margins with slender spines, especially prominent on the ventral surface. Terminal setae of caudal rami considerably stouter than in the female, the longest one as long as the entire posterior body.

First antennae 7-segmented, rather densely setose, the fourth segment enlarged and armed with two aesthetascs. Second antennae short and stout, the proximal segment a little longer than the distal and armed on its anterior margin with a stout seta. The outer ramus 2-segmented nearly as long as the distal segment and carrying five setae, two lateral, and three terminal. Mandibular palp with a broad, laminate terminal joint armed with a tuft of setae on its rounded tip and a single longer one on the inner margin near the center. Maxilliped of moderate size, the basal joint with two long setae and several smaller ones at the anterior distal corner; terminal joint about as long as the basal and considerably swollen, with four

or five long setae on its anterior margin; claw fully as long as the terminal joint and itself segmented near the base, where it carries a few long setae on its outer margin.

Endopod of first legs much longer than the exopod, with three fingerlike processes on the outer margin of the second segment. Endopod of second legs prehensile, the second segment tipped with two long and slender, spinelike appendages, closely juxtaposed, each ending in a minute claw. On the inner margin of this segment close to the bases of the spines are two setae, longer than the spines. Fifth legs with the terminal segment broadly triangular and armed with five large plumose setae and a much smaller nonplumose one, the third from the inner corner. Inner expansion of the basal segment not quite reaching the tip of the terminal segment and tipped with two plumose setae. A pair of rudimentary sixth legs on the ventral surface of the genital segment just behind the median suture, each consisting of a small knob tipped with three setae.

Color (preserved material).—Light brown.

Measurements.—Length: Female, 0.7 mm.; male, 0.8 mm.

Occurrence.—Several specimens, including but a single female, were taken in a bottom net at Station T on March 29, 1921, from water 9 meters deep over a muddy bottom. The species was not found elsewhere in the bay.

Types.—U.S.N.M. No. 58561, male, holotype; No. 63418, 2 males, 1 female, paratypes.

Remarks.—The single female was kept intact, and the description of the appendages is based upon those of the male, which are contrasted with the male of *tenuis*, the genus type, described by Sars.⁸ The chief points of difference are found in the general body form, especially the proportions of the various parts, and in the details of the second antennae, mandible, and second legs.

TACHIDIUS LITTORALIS Poppe

Tachidius littoralis POPPE, Abh. Naturw. Vereine, vol. 7, p. 149, pl. 6, 1881.

Occurrence.—A few females were taken at the surface at Station L' on October 19, 1920, in water 8 meters deep. A single female was captured in the bottom net at Station N' on January 25, 1921, in water 11 meters deep.

Remarks.—Poppe's specimens came from the mouth of the Ems River in northwestern Germany. Brady classed it as a brackish-water species found in estuaries and salt marshes. Such localities agree well with the two shallow water stations here in Chesapeake Bay, mentioned above. As far as known the species has not before been reported from American shores.

⁸ Crustacea of Norway, vol. 5, p. 334, pl. 222, 1909.

TISBE FURCATA (Baird)

Canthocamptus furcatus BAIRD, British Entomostraca, p. 210, pl. 25, figs. 1-2; pl. 30, figs. 4-6; 1850.

Idyaea furcata G. O. SARS, Crustacea of Norway, vol. 5, p. 88; pls. 51, 52, fig. 1, 1905; p. 367, 1910.

Occurrence.—Taken at Station G' in a vertical net on December 4, 1920, and at the surface on May 30, 1921, the latter haul yielding more than 200 specimens. One hundred and fifty specimens were also obtained in a bottom net on the 100-fathom line in the outside ocean.

Remarks.—The genus name of *Idya* being preoccupied, Lilljeborg's name of *Tisbe* must be substituted for it, not *Idyaea*. Sars said: "This is perhaps the commonest and most widely distributed of all our Harpacticoida." It is a littoral form and northern in its habitat, and possibly Chesapeake Bay is near the southern limit of its range.

Suborder CYCLOPOIDA

BOMOLOCHUS EMINENS Wilson

Bomolochus eminens WILSON, Proc. U. S. Nat. Mus., vol. 39, p. 368, pl. 53, figs. 148-154, text fig. 6, 1911.

Occurrence.—Half a dozen specimens, including both sexes, were obtained at Station P in a surface net on August 24 and in a bottom net on October 19, 1920. Development stages, probably of the same species, were also taken at this station.

Remarks.—This species was established to include certain specimens taken from the gill cavity of the false Spanish sardine, *Clupanodon pseudohispanicus*, at the Tortuga Islands. This fish is abundant about Cuba and in the Gulf of Mexico and goes northward along the Atlantic coast as far as Woods Hole. Either this or some closely allied fish probably serves as host to the *Bomolochus* parasite in Chesapeake Bay.

CORYCELLA^{*} CARINATA (Giesbrecht)

Corycaeus carinatus GIESBRECHT, Fauna und Flora des Golfes von Neapel, vol. 13, p. 675, pl. 51, figs. 20, 26, 1892.

Occurrence.—About 40 specimens, all females, were obtained at the surface on the 100-fathom line on August 21, 1921, and a few were taken in a vertical net at Station G in the mouth of the bay on December 4, 1920.

Remarks.—This is evidently a pelagic form and does not get far into the bay. From the dates given by other authors, this copepod is probably found throughout the year in the open ocean.

^{*}The name *Corycella* Farran, 1911, was used by Leger for a genus of Protozoa in 1893. Blake has proposed in manuscript the name *Farranula* for this genus, but as it has not yet been published *Corycella* is retained here.

CORYCAEUS ELONGATUS Claus

Corycaeus elongatus CLAUS, Die frei lebenden Copepoden, p. 157, pl. 24, figs. 3, 4, 1863.—GIESBRECHT, Fauna und Flora des Golfes von Neapel, vol. 19, p. 674, pl. 15, figs. 6, 7, 1892.

Occurrence.—A few specimens, including both sexes, were taken in a bottom net at Station C on December 20, 1920, and a few females were captured in a surface net in the outside ocean on August 21, 1921.

Remarks.—This copepod advanced a little farther into the bay during winter than *Corycella carinata*. According to the authors the present species does not seem to be abundant anywhere, but is always found in small numbers. This fact and its small size make it of no economic importance in the plankton of the bay.

CORYCAEUS LUBBOCKII Giesbrecht

Corycaeus lubbockii GIESBRECHT, Fauna und Flora des Golfes von Neapel, vol. 19, p. 674, pl. 51, figs. 57, 58, 1892.

CORYCAEUS ROBUSTUS Giesbrecht

Corycaeus robustus GIESBRECHT, Fauna und Flora des Golfes von Neapel, vol. 19, p. 673, pl. 51, fig. 38, 1892.

CORYCAEUS ROSTRATUS Claus

Corycaeus rostratus CLAUS, Die frei lebenden Copepoden, p. 157, pl. 28, fig. 5, 1863.—GIESBRECHT, Fauna und Flora des Golfes von Neapel, vol. 19, p. 674, pl. 51, fig. 16, 1892.

CORYCAEUS SPECIOSUS Dana

Corycaeus speciosus DANA, Wilkes Expedition, Crustacea, vol. 14, pt. 2, p. 1220, pl. 86, fig. 1, 1, a-d, 1853.—GIESBRECHT, Fauna und Flora des Golfes von Neapel, vol. 19, p. 673, pl. 51, fig. 40, 1892.

Occurrence.—These four species of *Corycaeus* were found in small numbers at the surface on the 100-fathom line, and were not taken within the limits of the bay.

Remarks.—From the locality where they were found it will be seen that these four species are pelagic copepods not likely to be taken within the limits of the bay. Moreover they are not found anywhere in abundance but always in very small numbers. Together with their small size, this prevents them from becoming of economic importance.

CORYCAEUS VENUSTUS Dana

Corycaeus Venustus DANA, Wilkes Expedition, Crustacea, vol. 14, p. 1222, pl. 86, fig. 4a, 1853.—GIESBRECHT, Fauna und Flora des Golfes von Neapel, vol. 19, p. 674, pl. 51, figs. 32-34, 47, 1892.

Occurrence.—Found in small numbers at Stations B, C, E, and F in surface and vertical nets during autumn and winter; also in surface and bottom nets on the 100-fathom line in the outside ocean.

Remarks.—This was the most widely distributed species of *Corycaeus* in the bay, but like all the others it occurred only in very small numbers. It is quite different from the other species in dorsal view and may be recognized without much difficulty.

CRYPTOPONTIUS GRACILIS, new species

PLATE 4, J-S

Specific characters of female.—Anterior body broadly expanded but not strongly depressed, with the epimeral lappets close together and curved backward. Cephalothorax as wide as long and about a fifth longer than the remainder of the body, broadly rounded in front with no dorsal crista; rostral projection minute. Lappets on the second and third thoracic segments broad and pointed, those on the third segment not reaching the center of the genital segment. Lappets of the fourth segment very small and conical in form, almost wholly concealed in dorsal view. Fifth segment very short and narrow and without lappets. Anterior half of genital segment dilated laterally to nearly twice the width of the posterior half. Abdomen with three segments, decreasing in width, but increasing in length posteriorly. Caudal rami as wide as long and rounded at the tip, each carrying five setae, of which the second from the inside is the longest and the second from the outside is the shortest.

Anterior antennae with nine segments, of which the second is short and the third and ninth quite long. According to Giesbrecht's interpretation the long third joint represents segments 3 to 8 fused, the fourth joint segments 9 to 11 fused, the fifth joint the twelfth segment, the sixth, seventh, and eighth joints three segments each, and the ninth joint segments 22 to 25 fused. On this basis the large aesthetask, which is two-thirds as long as the entire antenna, is attached to the twenty-third segment.

The posterior antennae are 4-segmented, the second and fourth joints about equal and much longer than the first and third, the middle terminal seta stout and rigid. The rudimentary exopod is rather large and is tipped with a single seta. The mouth tube is slender and extends nearly to the posterior margin of the cephalothorax; its basal portion is a little more than six times as wide as the terminal. The outer lobe of the maxilla is two-thirds as long as the inner, with a single stout apical seta, while the inner lobe ends in a minute seta. The terminal segment of the second maxilla is but little longer than the basal and enlarged at its tip, with a short and stout terminal claw. The terminal claw of the maxilliped is stout and is not so long as the second and third joints combined.

Specific characters of male.—Cephalothorax a fifth longer than wide and also a fifth longer than the rest of the body. The first antennae have ten segments, with aesthetasks of half the length of

the entire antenna on the dorsal surface of segments two to eight. The entire genital segment is dilated to twice the width of the abdomen; the latter has four segments, of which the basal and terminal are twice the length of the other two.

Color (preserved material).—Uniform yellowish white.

Measurements.—Length: Female, 1 mm.; male, 0.85 mm.

Occurrence.—Six specimens, including both sexes, were taken in a bottom net at Station A on December 5, 1920, in water 46 meters deep over a bottom of black mud. This station is well inside the mouth of the bay, and the species may occur elsewhere.

Types.—U.S.N.M. No. 58562, male, holotype; No. 63419, 1 male, 4 females, paratypes.

Remarks.—This species is closely related to *brevifurcatus*, the type of the genus, but differs in the greatly increased width and decreased length of the cephalothorax of the female, and in the details of the various appendages, especially the mouth tube and the first maxillae. In Sars's figure of the female of *brevifurcatus* the cephalothorax is twice as long as wide and also twice as long as the remainder of the body. In Giesbrecht's figure of the male the cephalothorax is only one-fifth longer than wide, but is nearly twice as long as the remainder of the body. These are very different proportions from those here given. In the female Sars makes the mouth tube ten times as long as its basal width, with the terminal portion exceedingly slender and tapering regularly to the tip. Here the length is only five times its basal width, and the terminal portion is stout and somewhat enlarged at the tip.

HEMICYCLOPS AMERICANUS, new species

PLATE 5, A-H

Specific characters of female.—Body cyclopoid and fairly stout, with the anterior division sharply separated from the posterior, strongly depressed and obovate in outline. Cephalic segment considerably wider than its length on the midline, and longer than the four succeeding segments combined, with a small triangular rostral process, invisible dorsally. Epimeral plates of the second, third, and fourth segments close together and rounded at their posterior corners, the fourth segment a little more than half the width of the cephalon. Fifth segment abruptly contracted to half the width of the fourth, swollen through the bases of the fifth legs, and strongly narrowed anteriorly. Genital segment a little wider than fifth segment anteriorly but tapered posteriorly, with a median transverse suture visible at the sides but fading out on the dorsal surface. Abdomen of three segments slightly tapered, the basal segment the longest, the second

segment the shortest. Caudal rami twice as long as wide, rounded at their tips and almost parallel. Egg cases elongate-ovate in form, reaching the anterior margin of the last abdominal segment.

First antennae reaching but little beyond the center of the cephalothorax, abruptly bent at their base and considerably tapered, the second and fourth segments the longest. Second antennae projecting beyond the margin of the carapace, penultimate joint wider than long, much shorter than the antepenultimate and terminal joints; distal corner strongly produced and armed with a tuft of stout setae; terminal joint tipped with six strong setae, four of which are geniculate, and a few short bristles.

First maxillae tipped with two stout spines and two setae on the inner margin inside the spines; palp tipped with four setae, with a well-defined lobe on the inner margin, also bearing four setae. Second maxillae with two coarse setae and a tiny one between them near the tip of the proximal joint on the inner margin; distal joint tipped with two stout clawlike spines and two setae about as long as the spines. Maxillipeds with the middle joint slightly swollen on the inner margin and armed with two plumose setae; terminal joint tipped with two plumose setae, but without any curved spines.

Swimming legs with the endopods longer than the exopods, the spines on both rami slender, minutely pectinate and armed just below the tip with a threadlike cilia. Fifth legs with a widened proximal joint carrying a stout seta on the anterior distal corner; distal joint laminate, densely ciliate on the lateral margins, with a few minute spines on the posterior margin near the tip, an apical spine accompanied by a bristle, and three spines on the anterior margin, all the spines pectinate.

Color (preserved material).—Clear yellowish white.

Measurements.—Length of adult female, 1.65 mm.; width of cephalothorax, 0.65 mm.

Occurrence.—Two females were obtained in a bottom net at Station R' in water 7 meters deep over a bottom of muddy sand on June 2, 1921; four females in a bottom net at Station W on March 25, 1921, in 13 meters of water over a muddy bottom; and two females at the latter station in a bottom net on June 3, 1921. The first two are made the types.

Types.—U. S. N. M. No. 58563, holotype; No. 63420, paratype.

Remarks.—From the record just given it is evident that this copepod is probably a bottom species, found in the brackish water of the inner bay during spring and summer. The type species of the genus, *purpureus*, was found by Sars in the Christiana Fiord on the Norwegian coast and was also recorded by T. Scott from the coast of Scotland.

METACYCLOPS GRACILIS (Lilljeborg)

Cyclops gracilis LILLJEBORG, De Crustaceis ex ordinibus tribus in Scania occurrentibus, Appendix, p. 208, 1853.

Mesocyclops gracilis G. O. SARR, Crustacea of Norway, vol. 6, p. 63; pl. 39, 1914.

Metacyclops gracilis KIEFER, Das Tierreich, Lief. 53, p. 72, 1929.

Occurrence.—Fourteen specimens of this species were taken in a surface net at Station Z on October 17, 1920, in water 13 meters deep over a muddy bottom.

Remarks.—This is a fresh-water species that has been found in central Europe and on the Scandinavian peninsula, but has not been heretofore reported from American waters. The salinity at the surface where the specimens were obtained was 10.4, which is not high enough to offer any serious obstacle to their presence. They might easily have drifted out of the Patapsco River, the mouth of which is just above Station Z. But it is also evident that their presence at the station was accidental, and that they are not likely to be found in any abundance or to be widely distributed in the bay.

OITHONA BREVICORNIS Giesbrecht

PLATE 3, I; PLATE 5, I-N

Oithona brevicornis GIESBRECHT, Atti Accademei Lincei, Rome, ser. 4, vol. 7, p. 475, 1891; Fauna und Flora des Golfes von Neapel, vol. 19, 538, pl. 34, figs. 6, 7, 1892.—FARRAN, Proc. Zool. Soc. London, 1913, p. 191.

Farran gave the following specific characters in the reference given above: "Rostrum present, ventrally directed, short, curved, not visible in dorsal view; exopod of first foot with 1.1.3 outer edge spines; exopod of fourth foot with 1.1.2 outer edge spines; length 0.7 mm." Giesbrecht in the second reference above, under the diagnoses of the species of *Oithona* on page 754, enumerated the following characters for the present species: "Forehead ending in a pointed rostrum, directed ventrally and not visible in dorsal view. First antennae scarcely reaching the posterior margin of the front body or falling distinctly short of it. Furca longer than the anal segment. Length 0.7 mm." The present specimens agree with these diagnoses except that the caudal rami are sometimes apparently shorter than the anal segment. In Giesbrecht's figure of the female in dorsal view (pl. 34, fig. 6) he put in a short anal segment next to the caudal rami similar to the one seen in the male. This was visible in about half the Chesapeake Bay specimens, but in the other half it was indistinguishably fused with the segment in front of it, and the two together were longer than the caudal rami. Giesbrecht also wrote that the male was unknown, and Farran accepted his statement. The only description of the female is the one given by Giesbrecht, which is extremely brief and tells us nothing about the appendages. Accordingly a

detailed description is here given of both sexes, with figures of the appendages to supply the omitted details.

Specific characters of female.—Body of the usual slender form but relatively stouter than in any species except *robusta* and *hebes*, the width of the anterior portion being nearly half its length. Rostrum considerably shorter than that of *similis* and *robusta*, pointed and curved over ventrally so as to be wholly invisible in dorsal view. Head more or less completely fused with the first thoracic segment, the dividing suture often practically invisible. Head itself half the length of the anterior body; first thoracic segment as wide as the head, the second, third, and fourth segments tapering regularly backward, the fourth one a trifle more than half the width of the first. Fifth segment abruptly contracted into a narrow neck anteriorly, swollen through the bases of the fifth legs to twice the width of the neck, and contracted again posteriorly. Genital segment swollen anteriorly and tapered posteriorly, as long as the entire abdomen, with the transverse suture just in front of the center. Abdomen of three segments, the terminal or anal one the shortest and often indistinguishably fused with the one in front of it. Caudal rami longer than this anal segment, more than twice as long as wide, each tipped with four setae. The second seta from the outside is the longest and is curved inward across the base of the one next to it, which is second in length.

First antennae slender and, when reflexed, reaching the posterior margin of the second thoracic segment; composed of about 11 segments, but the grooving of the basal portion is so faintly defined as to be very uncertain. Second antennae 2-jointed, the terminal joint a little shorter than the basal and tipped with a tuft of six plumose setae, with three others on the outer margin nearer the proximal end. First maxillae with the masticatory lobe large and tipped with two very stout setalike appendages, and on the outer margin a small jointed knob carrying spines; proximal lobe recurved, ending in three long setae, with two other shorter ones on the outer margin. Second maxillae 5-jointed, basal joint with three setae and a knob bearing three other setae; second with two setae; third joint with two large setae and a third much smaller one; fourth joint with a single seta on each distal corner; fifth joint tipped with two setae. The large setae are branched rather than plumose, the branches scattered and much too large for plumes. Maxillipeds 4-jointed, basal joint with one large and two small setae; second joint with two large setae; third joint with two of moderate size; last joint with one large and a smaller one. Swimming legs like those of other species of *Oithona*, the exopod of the first pair with 1.1.3 outer-edge spines, and the exopod of the fourth pair with 1.1.2 outer-edge spines.

Specific characters of male.—Body proportionally wider than in the female; length of anterior body to width as 16 to 9 (as 9 to 4 in the female); greatest width at posterior margin of cephalothorax, while in the female it is a short distance in front of that margin. Second segment as wide as the cephalothorax, third segment narrowed a little, fourth segment abruptly contracted to three-fifths of the width of the third segment; fifth segment nearly circular in outline, fifth legs longer than in the female. Genital segment ovate, armed on the dorsal surface at each posterior corner with a long seta. Abdomen of four segments, all the same width; caudal rami considerably longer than the anal segment and three times as long as wide.

First antennae apparently 14-jointed, but with the jointing of the basal portion very indistinct; terminal portion made up of two joints of about the same length. The basal portion of each antenna is bent near its center, and the joint at the flexure is armed at its distal posterior corner with a small spine inside of which is a rather long seta. The second antennae and mouth parts are like those of the female.

Measurements.—*Female*: Total length, 0.6 mm.; length of anterior body, 0.33 mm.; greatest width, 0.15 mm.; length of posterior body, 0.27 mm. *Male*: Total length, 0.55 mm.; length of anterior body, 0.32 mm.; greatest width, 0.18 mm.; length of posterior body, 0.23 mm.

Occurrence.—Taken at every station in the bay except U, abundant everywhere and sometimes constituting 50 per cent or more of the total catch. More abundant in the inner bay than in the outer, although the two largest single hauls of the species were both made in the outer bay.

Distribution.—Western Pacific near Hong Kong (Giesbrecht); Mediterranean (Pesta, Giesbrecht); Atlantic Ocean, latitude 6° S. (Cleve); Woods Hole (Fish).

Remarks.—The peculiar crossing of the long setae on the caudal rami of the female is a notable characteristic of this species. It is one of the smallest copepods in the bay, but also next to the two *Acartias* it is the most widely distributed. Hence its regular occurrence and comparative abundance more than offset its diminutive size and make it of great economic importance in the plankton. It was not found by Esterly on the California coast, but its place was taken by *Oithona nana*, another of Giesbrecht's species. A comparison of specimens taken at Woods Hole in the summer of 1923 with these from Chesapeake Bay shows that the two are the same species. Fish has recorded it as a summer form, while in Chesapeake Bay it was found throughout the entire bay during both summer and

winter. It is also found in the outer bay during autumn and probably during spring and in the inner bay during spring. Cleve, in discussing the geographical distribution of Atlantic Copepoda and their physical conditions,¹⁰ gave 20.29 as the mean salinity of the water in which this species was found. In the records here given the average salinity is much less than that, and at several stations was less than 10. This species, therefore, can accommodate itself to marked changes in salinity with almost as much ease as the two species of *Acartia* and *Harpacticus gracilis*.

OITHONA PLUMIFERA Baird

Oithona plumifera BAIRD, Newman's Zool., vol. 1, p. 59, 1843.—GIESBRECHT, Fauna und Flora des Golfes von Neapel, vol. 19, p. 754; pls. 4, 34, 44, 1892.

Occurrence.—This copepod was not found within the limits of the bay, but many specimens were obtained in the bottom net from depths of 20 and 118 fathoms in the outside ocean.

Remarks.—This is a pelagic form and not likely to be found within the limits of the bay. It has never been found anywhere in sufficient abundance to become of more than scientific interest.

OITHONA SIMILIS Claus

Oithona similis CLAUS, Die Copepodenfauna von Nizza, p. 14, 1866.—G. O. SARRS, Crustacea of Norway, vol. 6, p. 6 (1918, p. 207), pl. 3, 1913.

Occurrence.—Found at every station in the bay except D, H, M, and U; found much more abundant in the inner bay, but not so well distributed nor in such large numbers as *brevicornis*; decidedly a winter form but present also at other seasons.

Remarks.—Fish lists this copepod as a summer form at Woods Hole, and Wheeler obtained his specimens in July. Chesapeake Bay is much farther south, and while this species was found sometimes in summer in the outer bay, it was taken almost exclusively during autumn and winter in the inner bay. Like *brevicornis*, it was present in sufficient numbers to offset its diminutive size and formed an important addition to the plankton.

OITHONA SPINIROSTRIS Claus

Oithona spinirostris CLAUS, Die frei lebenden Copepoden, p. 105, pl. 11, figs. 4-9, 1863.—G. O. SARRS, Crustacea of Norway, vol. 6, p. 6, pls. 1, 2, 1913.

Occurrence.—A few specimens were taken in a surface net at Station G on December 4, 1920. About 40 specimens were also obtained in a bottom net at a depth of 20 fathoms in the outside ocean during the trip to the 100-fathom line on August 21, 1920.

¹⁰ Oversigt af Kongl. Vetenskaps-Akademiens Förhandlingar, p. 139, 1900.

Remarks.—This species has been generally confused with *plumifera*, but it lacks the plumes, which are the essential characteristic of that species, and is considerably larger. Like *plumifera* it is a pelagic form, widely distributed over the northern Atlantic, but not likely to penetrate very far into the bay. Sars said of it: "To judge from the structure of the oral parts, the animal must be of a very rapacious nature, probably feeding upon other small pelagic animals."¹¹

ONCAEA MINUTA Giesbrecht

Oncaea minuta GIESBRECHT, Fauna und Flora des Golfes von Neapel, vol. 19, p. 603, pl. 47, figs. 3, 6, 26, 46, 59, 1892.—G. O. SARS, Crustacea of Norway, vol. 6, p. 217, pl. 118, fig. 2, 1918.

Occurrence.—About 25 specimens were obtained in a surface net at Station C on August 22, 1920. A few females were also taken at the surface at Station E on October 21, in a bottom net at Station F on August 22, and in a bottom net at Station L on August 25.

Remarks.—This little cyclopid was taken only late in summer and in autumn, and in very small numbers, except at Station C. It has not been reported as abundant anywhere and hence does not become of real importance in the plankton.

ONCAEA VENUSTA Philippi

Oncaea venusta PHILIPPI, Arch. Naturg., vol. 9, p. 111, fig. 3, 1843.—GIESBRECHT, Fauna und Flora des Golfes von Neapel, vol. 19, p. 602, pl. 3, fig. 7; pl. 47, figs. 2, 5, 13, 19, 39, 44, 48, 1892.

Occurrence.—One hundred specimens were obtained at the surface on the 100-fathom line in the outside ocean and 150 in the bottom net. Six hundred were obtained at the surface in water 67 fathoms deep, and 15 in the surface and bottom nets where the depth was 10 fathoms. A single female was found in the mouth of the bay.

Remarks.—This is apparently a pelagic form and widely distributed in all the oceans, to judge from the localities given by various authors. Hence it is not likely to be found inside of the very mouth of the bay.

SAPPHIRINA GEMMA Dana

Sapphirina gemma DANA, Wilkes Expedition, Crustacea, vol. 14, p. 1252, pl. 88, fig. 1, *a-f*; fig. 2, *a-g*; 1853.—GIESBRECHT, Fauna und Flora des Golfes von Neapel, vol. 19, p. 640, pl. 3, fig. 4; pl. 52, figs. 3, 4, 62, 64; pl. 53, figs. 19, 31, 32, 61; pl. 54, figs. 10, 12, 46; 1892.

Occurrence.—A few specimens, including both sexes, were obtained in the bottom net drawn from depths of 40 and 118 fathoms during the trip to the 100-fathom line in the outside ocean.

¹¹ Crustacea of Norway, vol. 6, p. 7, 1918.

Remarks.—Though captured swimming freely this copepod lives commensally within some species of *Salpa*. According to Giesbrecht it uses *S. democratica* as a host, but Wheeler's specimens were taken in company with *S. cordiformis*.

SAPPHIRINA SINUICAUDA Brady

Sapphirina sinuicauda BRADY, Challenger Expedition, Copepoda, vol. 8, p. 129, pl. 49, figs. 7–10, 1883.—GIESBRECHT, Fauna und Flora des Golfes von Neapel, vol. 19, p. 648, pl. 52, figs. 31, 33, 34; pl. 53, figs. 42, 50; pl. 54, figs. 26, 36, 70, 1892.

Occurrence.—About 40 specimens of this species were taken in a bottom net at the 100-fathom line in the outside ocean; none were found within the limits of the bay.

Remarks.—Like *S. gemma*, this is also a pelagic form and not likely to be found within the limits of the bay. Thus far all the specimens have been captured while swimming freely, but like other species of the genus it is probable that the present one lives commensally within some species of *Salpa*.

Suborder CALIGOIDA

CALIGUS SCHISTONYX Wilson

Caligus schistonyx WILSON, Proc. U. S. Nat. Mus., vol. 28, p. 564, pl. 6, figs. 65–78, 1905.

Occurrence.—Several specimens were obtained in the surface net at Station G in the mouth of the bay on October 21, and in the vertical net on December 4, 1920. Others were captured in both surface and bottom nets at Station C on October 20, 1920. All the specimens taken were swimming freely in the tow.

Remarks.—Of the 15 lots of this species already in the collection of the United States National Museum, 9 were obtained from the tow. This species is very often captured when swimming freely, probably because it is an external parasite on the common menhaden (*Brevoortia tyrannus*). These fishes serve as the prey or food of other fishes, and while being caught and eaten some of their external parasites would naturally be set free in the water.

SPECIMENS DEPOSITED IN THE UNITED STATES NATIONAL MUSEUM
AND INDEX OF SPECIES

Out of the large number of specimens here recorded, those listed in Table 4 have been selected to serve as types of the new species and as samples of the identification of the other species. Considerable care was exercised in the selection of these samples, in order that they might exhibit the average characteristics of the species.

TABLE 4.—*Specimens of copepods reported upon in this paper deposited in the United States National Museum, and index of species*

SPECIES	U. S. N. M. No.	STATION	PAGE
<i>Acartia clausii</i>	58472	J	19
	58482	Y	
	58504	C	
	58514	C	
	58549	Z	
	58441	E	
<i>Acartia longiremis</i>	58458	F	20
	58506	100-f. l.	
	58512	C	
	58514	C	
<i>Alteutha depressa</i>	58528	F	33
<i>Amalophora brevicornis</i>	58557	100-f. l.	20
<i>Anomalocera patersoni</i>	58558	do.	21
<i>Bomolochus emineus</i>	58464	P	41
	58470	do.	
	58455	E	
<i>Calanus finmarchicus</i>	58477	G	21
	58502	100-f. l.	
	58509	do.	
<i>Calanus helgolandicus</i>			21
<i>Caligus schistonyx</i>	58446	G	51
<i>Candacia armata</i>	58496	100-f. l.	22
	58503	40-f. l.	
<i>Canualla elongata</i> , new species.....	2 58571		33
	63417	W	
<i>Centropages bradyi</i>	58543	100-f. l.	22
<i>Centropages hamatus</i>	58445	E	22
	58468	G	
	58521	100-f. l.	
<i>Centropages typicus</i>	58442	E	23
	58463	E	
	58484	G	
	58516	100-f. l.	
<i>Cletodes longicaudatus</i>	58454	R	35
<i>Olytemnestra rostrata</i>	58529	100-f. l.	35
<i>Corycaeus elongatus</i>	58453	C	42
	58497	do.	
<i>Corycaeus lubbockii</i>	58530	100-f. l.	42
<i>Corycaeus robustus</i>	58534	do.	42
<i>Corycaeus rostratus</i>	58515	do.	42
<i>Corycaeus speciosus</i>	58513	do.	42
<i>Corycaeus venustus</i>	58449	E	42
	58520	100-f. l.	
	58559	B	
<i>Corycella carinata</i>	58536	do.	41
	58542	G	

¹ 100-fathom line.² Type specimen.

TABLE 4.—*Specimens of copepods reported upon in this paper deposited in the United States National Museum, and index of species—Continued*

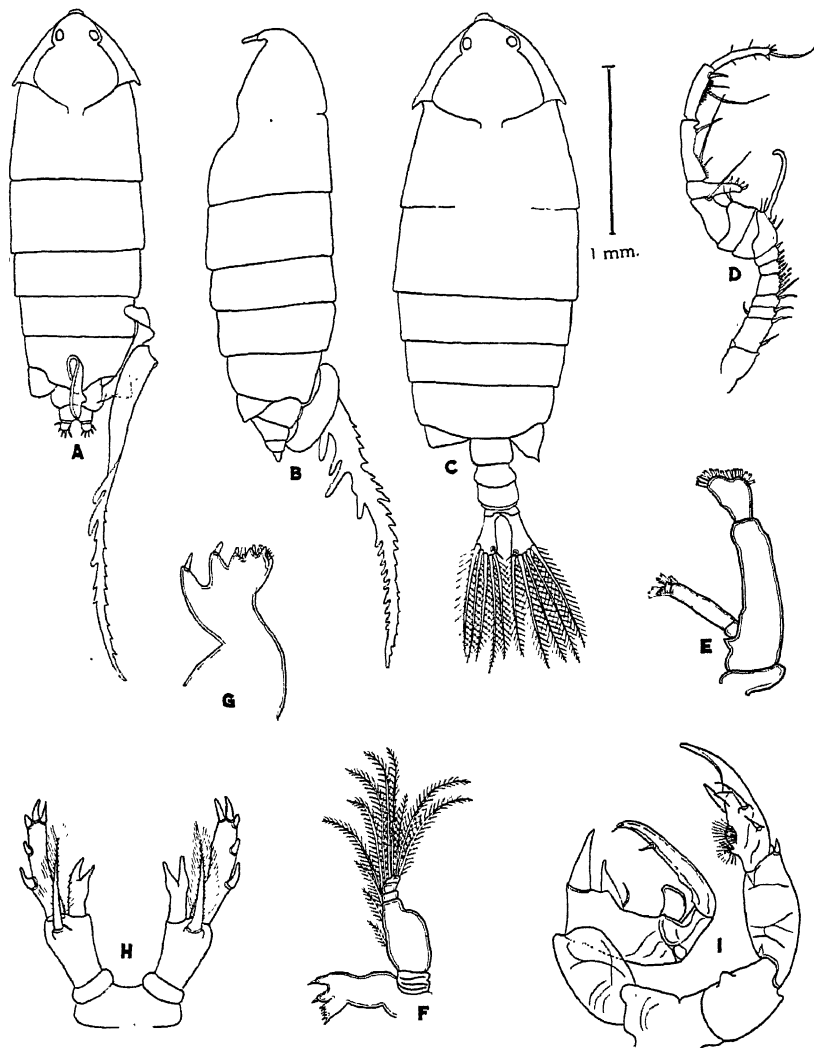
SPECIES	U. S. N. M. No.	STATION	PAGE
Cryptopontius gracilis, new species.....	{ * 58562 63419	{ A	{ 43
Dactylopusia brevicornis.....			35
Diosaccus tenuicornis.....	58468	F	36
Ectinosoma curticorne.....	{ 58469 58556	{ Z O	{ 36
Ectinosoma normani.....	58474	Y	36
Euchaeta norvegica.....	58495	100-f. l.	23
Eurytemora americana.....	58487	V	24
Eurytemora hirundoides.....	{ 58524 58550	{ M Z	{ 24
Harpacticus chelifer.....			37
Harpacticus gracilis.....	58493	V	37
Harpacticus littoralis.....	58466	R'	37
Hemicyclops americanus, new species.....	{ * 58563 63420	{ do	{ 44
	58452	G	
	58461	E	
	58485	Y	
Labidocera aestiva.....	{ 58499 58519 58523	{ 60-f. l. F A	{ 24
	58551	G	
Labidocera wollastoni.....	58490	G	25
Macrosetella gracilis.....	58572	100-f. l.	38
Mecynocera clausii.....	58494	do	25
Metacyclops gracilis.....			46
Metridis lucens.....	58501	100-f. l.	25
Microsetella norvegica.....	{ 58444 58459	{ E F	{ 38
Microthalestris littoralis.....	58463	N'	38
	58462	F	
Oithona brevicornis.....	{ 58510 58535	{ H' F	{ 46
Oithona plumifera.....	58490	100-f. l.	49
Oithona similis.....	58486	G	
	58552	F	49
Oithona spinirostris.....	58481	G	49
	58447	E	
Oncaea minuta.....	{ 58505 58564	{ 100-f. l. C	{ 50
Oncaea venusta.....	{ 5849 58533	{ 100-f. l. do	{ 50
	58443	E	
Paracalanus parvus.....	58518	100-f. l.	26
	58526	do	
Pontella atlantica.....	58555	100-f. l.	26
Pontella meadii.....	{ 58491 58554	{ do F	{ 26
	58565	C	
Pontella pennata, new species.....	{ 58567 * 58568 58566 63416	{ do do 100-f. l.	{ 27
	58467	E	
Pseudocalanus elongatus.....	{ 58476 58500 58525	{ Y 40-f. l. 100-f. l.	{ 29

* Type specimen

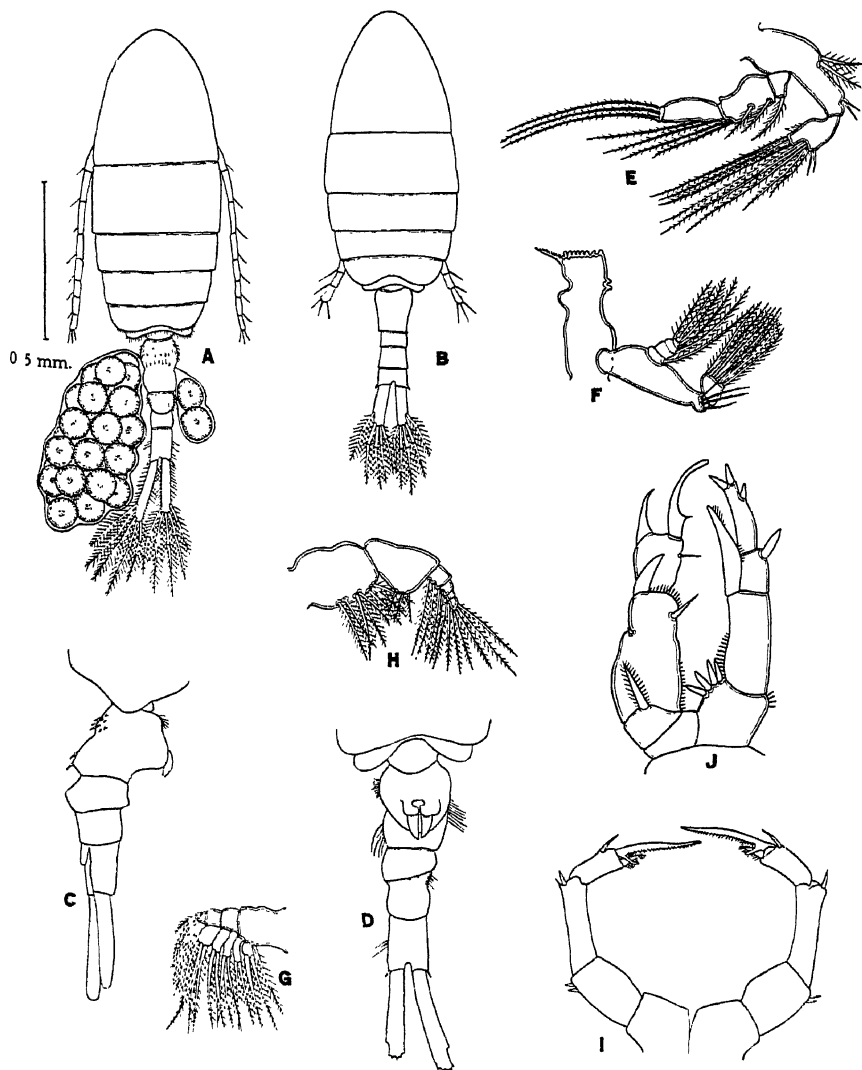
TABLE 4.—*Specimens of copepods reported upon in this paper deposited in the United States National Museum, and index of species*—Continued

SPECIES	U. S. N. M. No.	STATION	PAGE
<i>Pseudodiaptomus coronatus</i>	{ 58450 58475 58507 58511 58570	{ R' Y A C G'	{ 30
<i>Rhincalanus nasutus</i>	58489	100-f. l.	32
<i>Robertsonia chesapeakeensis</i> , new species.....	{ * 58561 63418	{ T	{ 39
<i>Sapphirina gemma</i>	58517	100-f. l.	50
<i>Sapphirina sinuicauda</i>	58508	do	51
<i>Tachidius littoralis</i>			40
<i>Temora discaudata</i>			32
<i>Temora longicornis</i>	{ 58451 58456 58460	{ G do do	{ 32
<i>Temora turbinata</i>	{ 58478 58560	{ G do	{ 33
<i>Tisbe furcata</i>	{ 58465 58492	{ F G'	{ 41

* Type specimen.

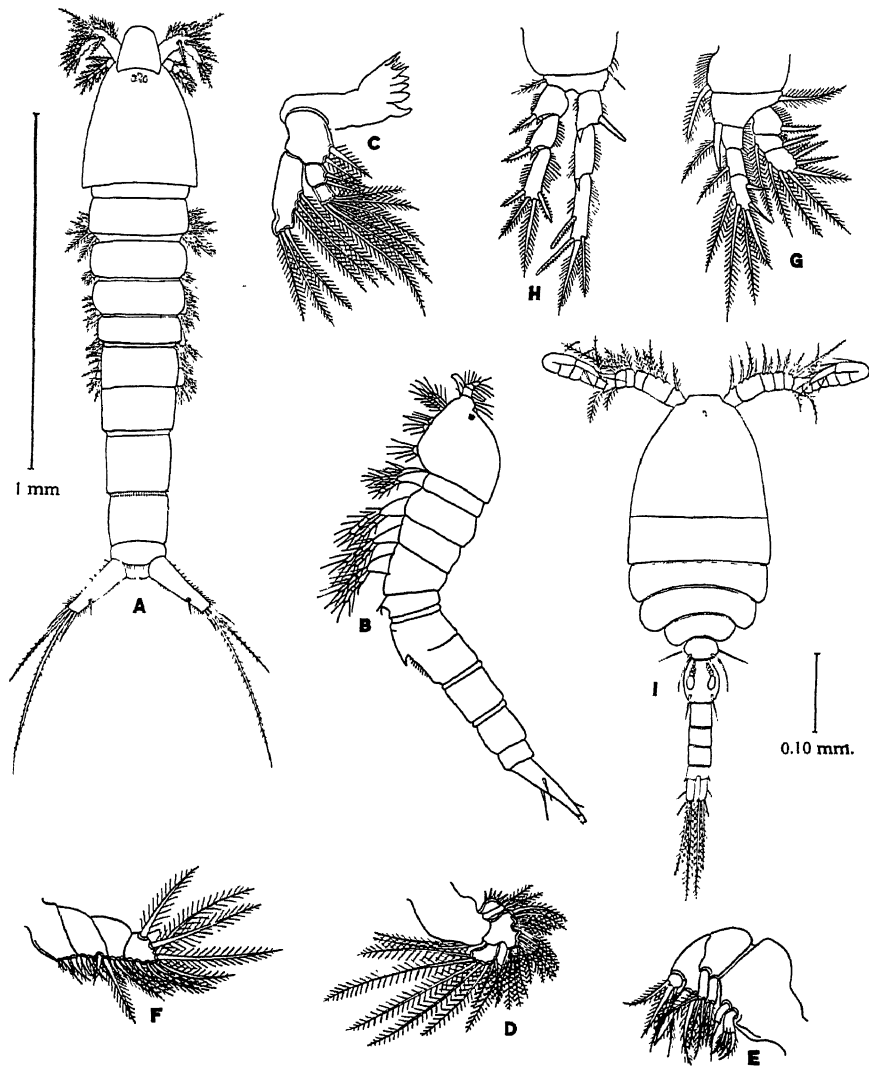
**PONTELLA PENNATA**

A, Dorsal view of female; B, side view of female; C, dorsal view of male; D, grasping antenna of male; E, second antenna of female; F, mandible and palp; G, mandible of male; H, fifth legs of female; I, fifth legs of male.



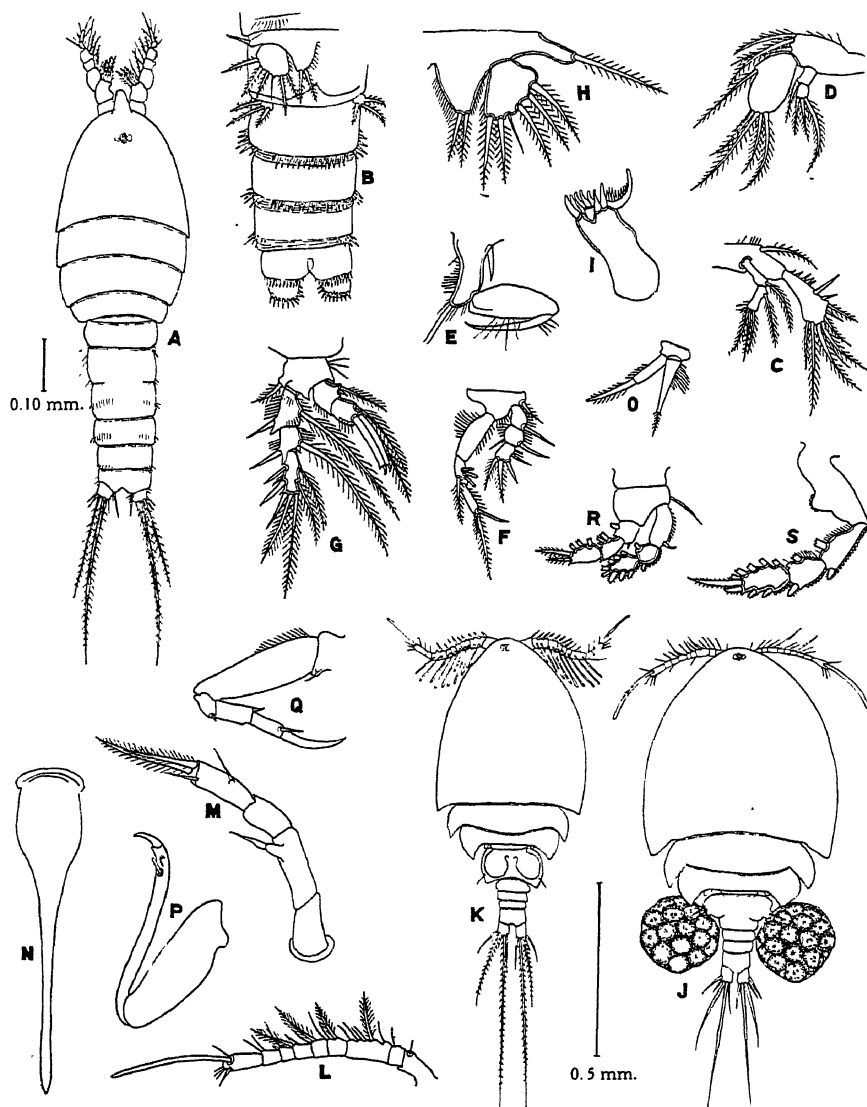
PSEUDODIAPTOMUS CORONATUS

A, Dorsal view of female; B, dorsal view of male; C, side view of posterior body of female; D, ventral view of posterior body showing asymmetry; E, second antenna; F, mandible and palp; G, second maxilla; H, maxilliped; I, fifth legs of female; J, fifth legs of male.



CANUELLA ELONGATA AND OITHONA BREVICORNIS

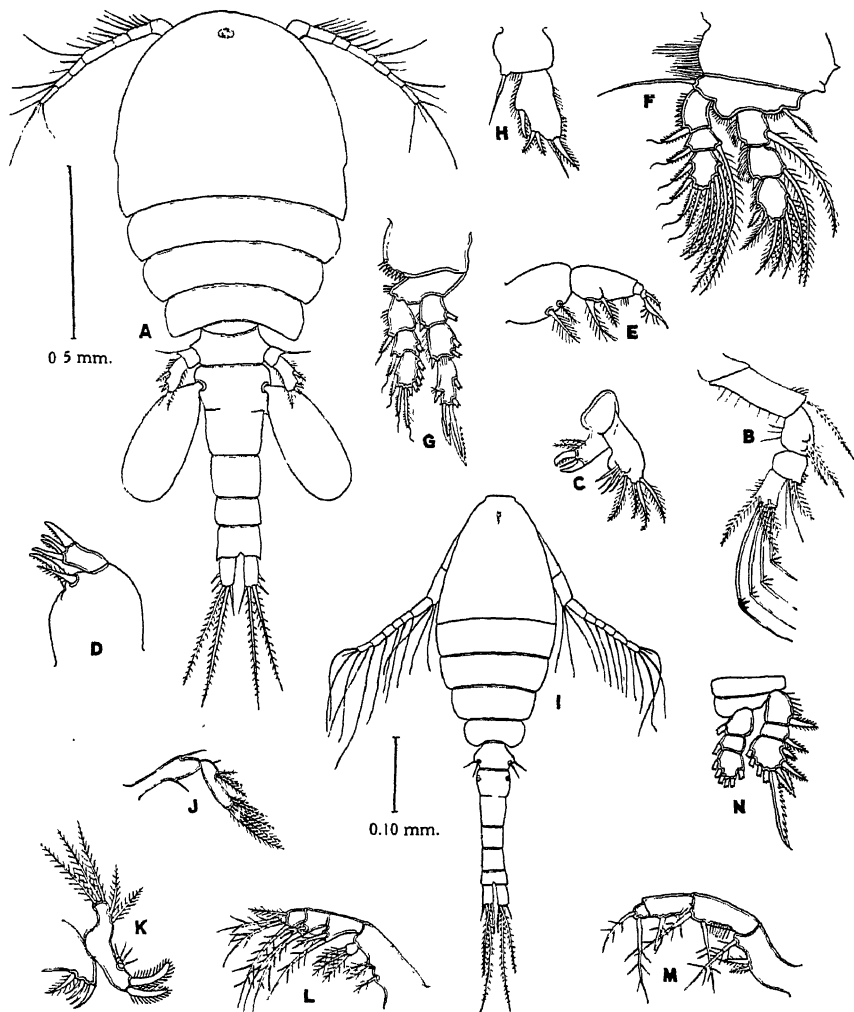
A-H, *Canuella elongata*: A, Dorsal view of female; B, side view of female; C, mandible and palp; D, first maxilla; F, maxilliped; G, first swimming leg; H, second swimming leg.
 I, *Oithona brevicornis*: Dorsal view of male.



ROBERTSONIA CHESAPEAKENSIS AND CRYPTOPONTIUS GRACILIS

A-I, *Robertsonia chesapeakensis*: A, Dorsal view of female; B, ventral surface of posterior body showing rudimentary sixth legs and spines on posterior margins of segments; C, second antenna; D, mandibular palp; E, maxilliped; F, first swimming leg; G, second leg; H, fifth leg.

J-S, *Cryptopontius gracilis*: J, Dorsal view of female; K, dorsal view of male; L, first antenna of female; M, second antenna; N, mouth tube; O, first maxilla; P, second maxilla; Q, maxilliped; R, first swimming leg; S, fourth leg.



HEMICYCLOPS AMERICANUS AND OITHONA BREVICORNIS

A-H, *Hemicyclops americanus*: A, Dorsal view of female; B, second antenna; C, mandible and palp; D, second maxilla; E, maxilliped; F, first swimming leg; G, fourth leg; H, fifth leg. I-N, *Oithona brevicornis*: I, Dorsal view of female; J, second antenna; K, first maxilla; L, second maxilla; M, maxilliped; N, first swimming leg.

THE ANCIENT CAVES OF SZECHWAN PROVINCE, CHINA

By DAVID CROCKETT GRAHAM

Collaborator, Smithsonian Institution

In the Province of Szechwan, in the western part of China, there are thousands of artificial caves. (Figs. 1, 2, 3.) They have been chiseled out of solid sandstone on the sides of hills and cliffs, and are found all the way from Hupeh Province on the east to the highlands of the Szechwan-Tibetan border. There are also similar caves along the Yellow River, in the Province of Kansu.¹

The caves are usually found in steep places, both singly and in groups. Many are difficult of access. They vary in depth from a few feet to 130 feet, and are generally about 6 feet wide and 6 feet high on the inside. The floors, sides, and tops are the solid stone out of which the caves have been carved. The marks of the

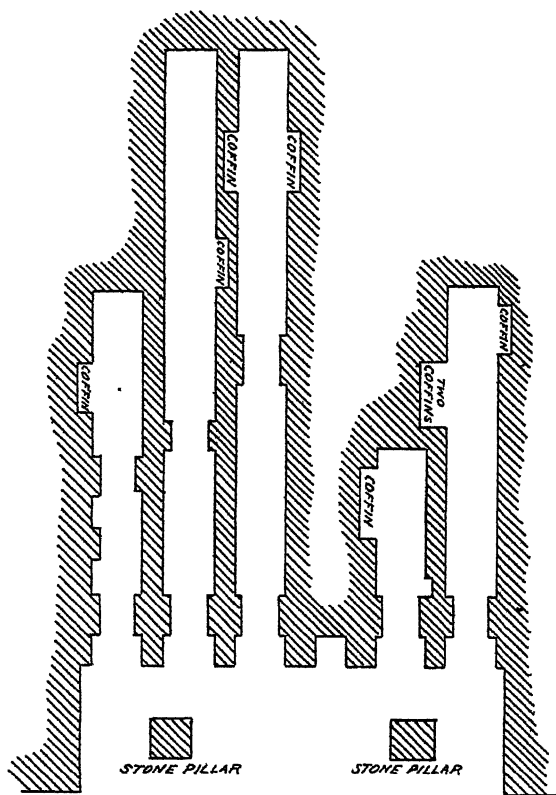


FIGURE 1.—Floor plan of a six-chamber cave, carved from the stone cliffs near Kiating. Native rock pillars have been left in the common entrance. Length, 130 feet; breadth, 54 feet

chisels can plainly be seen. Some caves are so close together that holes have been knocked through the walls that separated them. Excepting

¹ Bishop, C. W., *The problem of the Min River caves*, p. 1. Reprinted by the Peking Express Press from *The Chinese Social and Political Science Review*, vol. 10, no. 1, Peking, January, 1926.

in a few instances where steps have been made in the rock, there are no special approaches to the caves; the typical entrance is simply a square hole or door in the solid rock. While the best caves have elaborate carvings, which are above and around the front openings, or on the sides and pillars near the entrances, most of the caves have no carvings at all.

The popular belief is that these caves, called *mantsu dong*, or barbarian caves, were made and used as dwellings by aborigines who

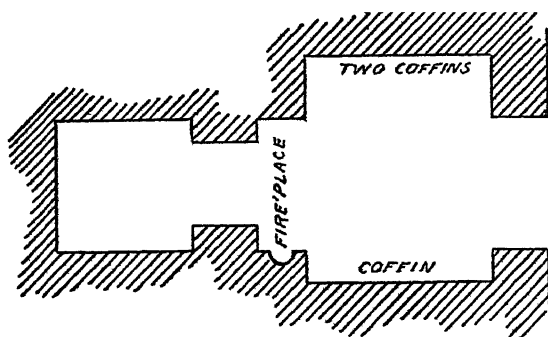


FIGURE 2.—Plan of a cave near Kiating. Length, 25 feet; width at rear, 6 feet

inhabited Szechwan Province before the arrival of the Chinese. There is increasing evidence, however, that they are Chinese tombs, and that they were constructed for burial purposes in the Han dynasty (206 B. C.-220 A. D.), and possibly during the early years of the Three Kingdoms. The

belief of the Chinese that the caves of Szechwan were aboriginal dwellings is probably due to the fact that the Chinese population of Szechwan Province was practically exterminated by Tsang Shien

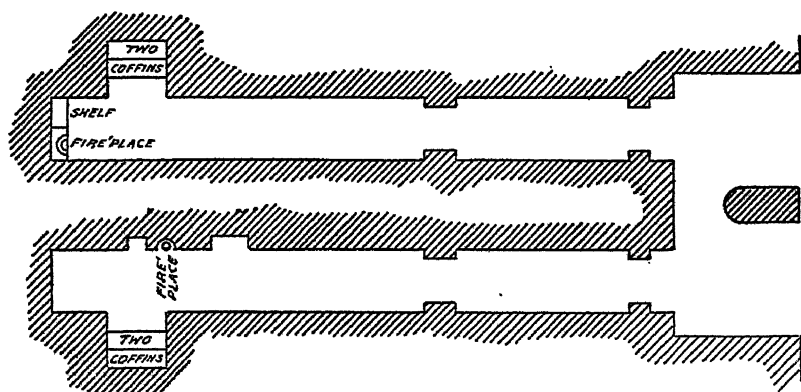


FIGURE 3.—Plan of double cave near Kiating. Total length, 61 feet; width of entrance, 21 feet

Tsong near the close of the Ming dynasty. The new immigrants naturally knew little about the past history of the Province.

There is reliable evidence that the Chinese took possession of Chengtu, the capital of the Province, about 300 B. C., and later extended their territory westward and southward. Monuments at

Yachow and near Lushan show conclusively that during the later Han dynasty the Chinese were in possession of Yachow. Kiating was in the hands of the Chinese during the Han dynasty, but for centuries after Christ the highlands west of Suifu, between the Yangtse and the Min Rivers, were under control of the aborigines. Suifu was a difficult place for the Chinese to take and occupy, and still more difficult to protect from the raids of the mantsus (barbarians) who lived in the mountains not far away. Chu Ko Liang, the famous Chinese warrior, placed a garrison in Suifu in 225 A. D. For centuries afterwards the city and surrounding country were included in the Kien Wei district and were governed either from Kien Wei or from Nan Ch'i. The Suifu history states that the whole Kien Wei district, which included the Suifu prefecture, was an aboriginal country, although governed by Chinese officials who lived in Kien Wei. The name Yong Cheo, or Mantsu Town, though later replaced by various other designations, and finally by Hsu Cheo Fu, has tended to cling to the city of Suifu until the present day.

If the aborigines made and lived in the Szechwan caves, the Suifu district should abound in them, for it has plenty of sandstone. Also, Suifu was one of the mantsu

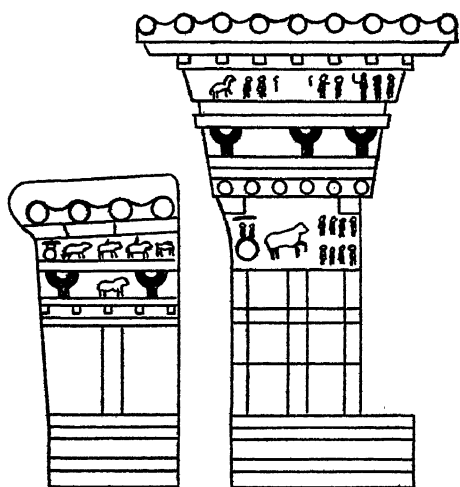


FIGURE 4.—Schematic drawing of the south side of a Han dynasty memorial arch near Yachow. Height about 25 feet

centers and was probably the last large city in Szechwan to be taken from the aborigines by the Chinese. There should be fewer caves near Chengtu, Kiating, and Yachow. But the fact is that at Suifu there are only four or five very small caves, while there are many near Yachow and Chengtu, and near Kiating there are probably thousands of them. So far as the writer has been able to learn, there are no similar artificial caves in Kweichow or Yunnan, or even in Tibet, where there are still large numbers of mantsus or aborigines. The caves of Szechwan are found in the territory occupied by the Chinese during the Han dynasty and at the beginning of the Three Kingdoms. Those in Kansu Province are reported to be along the Yellow River, in a territory that was probably inhabited by the Chinese centuries before Christ.

Near Yachow is a memorial arch, about 25 feet high, whose inscriptions show beyond doubt that it was erected in the later Han dynasty. It has elaborate carvings (fig. 4), which give an excellent basis for comparison with the carvings in the caves. In the public museum of Chengtu there are artifacts which were taken from Han dynasty graves on the Chengtu plain. Another interesting collection,



FIGURE 5.—A tile roof edge forms a decorative motif frequently found in caves throughout Szechwan Province

secured in the Szechwan caves, is preserved in the museum of the West China Union University.

In the historic museums of Peiping are many artifacts (some of which are from Han dynasty graves) dating from the Manchu dynasty back to the very beginnings of Chinese history. The Field Museum in Chicago, Ill., has a collection of articles from Han dynasty graves in eastern China. The Smithsonian Institution has nearly two hundred artifacts, mostly fragmentary, collected by the writer in the caves of Szechwan Province. The writer has visited the memorial arch at Yachow, the museums mentioned above, and many of the caves of Szechwan, and this article is largely the result of his impressions.²

The most common design used in the Szechwan caves is a decoration consisting of a series of circles, bridged by quarter circles resembling new moons. These are also conspicuous on the Han dynasty monument at Yachow and on memorial arches, shrines, temples, and even ordinary buildings throughout Szechwan Province. The same design probably occurs all over China, for it resembles the edge of a tile roof, the circles representing the ends of round beams

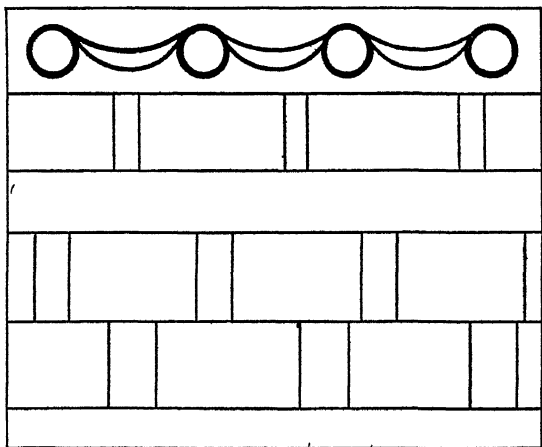


FIGURE 6.—This carving on the wall of a cave-tomb near Kiating portrays the side of a tile-roofed house

² The writer gladly acknowledges his indebtedness to Rev. Thomas Torrance and to Prof. Daniel Sheets Dye, of the West China Union University, both of whom have studied the Szechwan caves; also to Dr. Walter Hough, head curator, department of anthropology, and Neil M. Judd, curator of archeology, both of the U. S. National Museum, for their invaluable assistance in the preparation of this article.

or poles; the part circles, curved tiles such as are used throughout China. (Figs. 5, 6; pl. 14.)

Another common design observed in the caves is the brace, which is found in two forms. First is the half brace, employed as follows: When, in a building or on a memorial arch, the space between two upright posts is bridged by a long beam of wood or stone on which rests a heavy weight, half braces are often brought out from the uprights to strengthen the crossbeam. (Fig. 7.) These half braces, occasionally seen as ornamental carvings in the caves, are very common in Chinese architecture, and especially in buildings and on memorial arches.

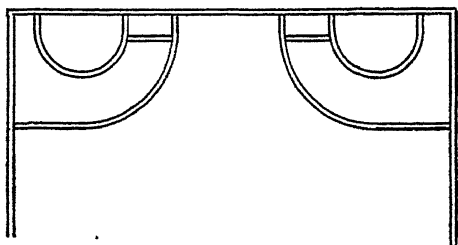


FIGURE 7.—Schematic drawing from a cave near Kiating, showing the type of half brace frequently seen in later Chinese buildings and memorial arches. Width, about 5 feet

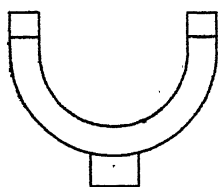


FIGURE 8.—A simple type of ancient Chinese brace

The regular or full brace in its simplest form somewhat resembles the letter U. (Fig. 8.) When a crossbeam bears up a heavy load, and is likely to break, another crossbeam may be placed a little way below, and several of the braces fitted between the two beams. This adds to the upper beam the strength of the lower beam. Many of these braces are carved as ornaments in the Szechwan caves (fig. 9);

several occur on the Han dynasty monument at Yachow. The writer has seen many more, some of which are elaborate in design, on memorial arches and in Chinese buildings, both in Szechwan Province and in Peiping. (Figs. 10, 11.)

In a cave near the great Buddha at Kiating there is a carving of a chariot drawn by a man. In the public museum at Chengtu there are two bricks from

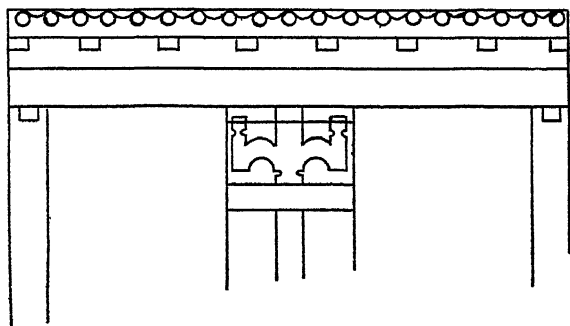


FIGURE 9.—Carved entrance to the double cave near Kiating. (See fig. 3 for plan.) Note representations of the tile roof and brace on central column

a Han dynasty grave on the Chengtu plain, on each of which is the design of a chariot pulled by a horse. These two chariots are similar

in shape. Three Han dynasty chariots of this kind are illustrated by S. W. Bushell in "Chinese Art."³ Some of the chariots represented on the Han dynasty arch at Yachow are of a different type and closely resemble the one pictured in "Outlines of Chinese History" by Li Ung Bing.⁴ Apparently both types mentioned above were common in China during the Han dynasty. The history of the Three Kingdoms frequently mentions chariots in Szechwan Province and in other parts of China.

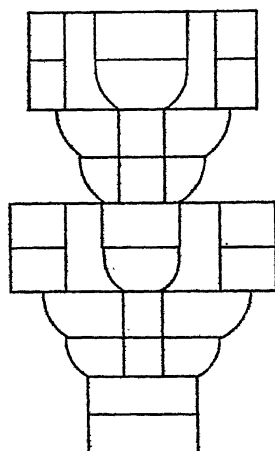


FIGURE 10.—Diagram of a brace made of bricks. Eight such braces hold up each story of the old Suifu pagoda

In two different caves near Kiating are carvings which represent, respectively, a house (fig. 12) and the roof of a similar building (fig. 13). Both resemble modern Chinese houses, especially in the upturned ends of the roofs.

In determining by whom and for what purposes the caves of Szechwan were made, the artifacts actually found in the caves are of primary importance. Are they Chinese or aboriginal? Are they such as are found in homes or in tombs?

Rev. Thomas Torrance, who has studied the Szechwan caves for years and was the first to assert that they were of Chinese origin, gives the following list of their contents:

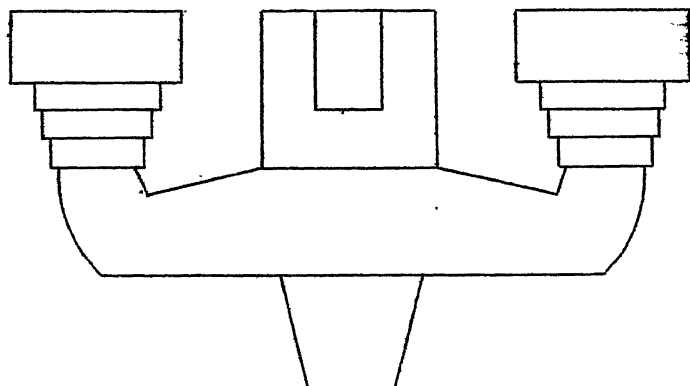


FIGURE 11.—Brace found at each side of a cave ten li west of Kiating.

Instead of straw or movable wooden figures of men you find them of burnt clay, gray and terra cotta in color, glazed and unglazed, from a few inches

³ Bushell, S. W., *Chinese Art*, vol. 1, opposite p. 28, published in London under the authority of the Board of Education, 1924.

⁴ Bing, Li Ung, *Outlines of Chinese history*, p. 36, Commercial Press, Shanghai, 1914.

high to nearly full life-size. They represent persons of both sexes and various ranks and callings. There are besides models of houses, cooking pots, boilers, rice steamers, bowls, basins, vases, trays, jars, lamps, musical instruments, dogs, cats, horses, cows, sheep, fowls, ducks, etc. Standing with your reflector lamp in the midst of a large cave it seems verily an imitation of Noah's ark.⁵

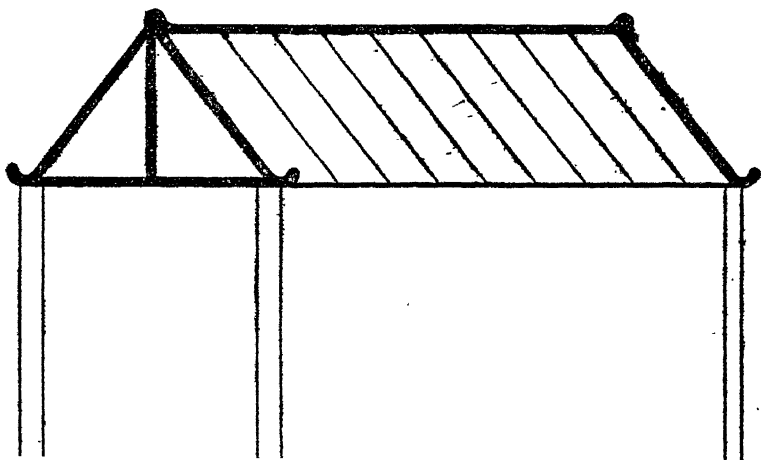


FIGURE 12.—Chiseled on the wall of a cave near Kiating is this representation of a house (slightly idealized)

The following are among the burnt-clay figures, mostly unglazed, secured by the writer in the Szechwan caves, and now in the United States National Museum.

(The accompanying numbers are U.S.N.M. catalogue numbers.)

Plate 1, b, illustrates a fragment of an elephant's foot (No. 342202). In the public museum at Chengtu is an unglazed artifact, taken from a Han dynasty grave on the Chengtu plain, on which are several images of elephants, very artistically designed. We have historical evidence that elephants were known in Szechwan during the early Christian centuries. An aborigine chief

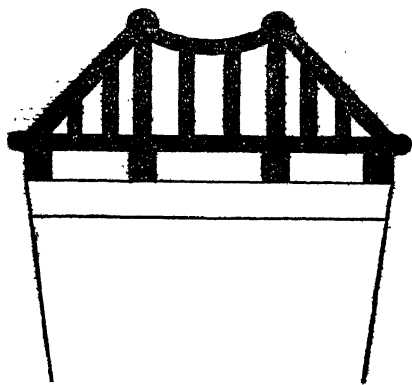


FIGURE 13.—Representation of a house roof, carved on a stone pillar in a cave-tomb near Kiating

is said to have ridden an elephant in a battle against Chu Ko Liang, and the saint, P'u Hsien, now worshiped as a god, is said to have ridden an elephant to Mount Omei.

⁵ Journal of the North-China Branch of the Royal Asiatic Society, vol. 41, p. 68. Kelly and Walsh, Shanghai, 1910.

One fragment is the neck of a large bottle or flask with the figure of a person clinging to it. (Pl. 2, *a*; No. 341358.) It is covered with green glaze, and the orifice was molded over a stick or other cylindrical object. It should be noted that glazed figures are rare in the caves of Szechwan.

A second specimen bearing green glaze is a fragment of a bell or drum. (Pl. 2, *b*; No. 341373.) The shape appears to have been similar to the Chou dynasty drums in the Confucian Temple at Peiping.

Fowls are frequently represented among the clay offerings from the Szechwan caves. Among others in our collection is the image of a duck, supported by a circular base. (Pl. 3, *a*; No. 342189.) On the back is what resembles a small pot or vessel with a flat top.

Chickens are frequently represented by the images found in the caves of Szechwan Province. Perhaps none is more characteristic than that shown in Plate 3, *b*, which represents a mother hen with one baby chicken on her back and three others peeping from under her breast. (No. 341385.)

The dog also provided a favorite theme for the ancient sculptors of Szechwan. Three such images are included in the series under consideration. One is merely a head fragment (pl. 4, *a*; No. 341346); another is the erect head and right foreleg of an animal at rest (pl. 4, *b*; No. 341335); while the third is the well-modeled body of a dog from which the head is missing (pl. 4, *c*; No. 342207). In the case of the first two, both have flat noses and short, alert ears. Of the numerous similar images examined by the writer, from the Szechwan caves and from Chinese tombs dated in the Han dynasty, only one had a pointed nose. Flat or pug noses, short ears, and tails curled up over their backs are common characteristics of dog figures from both the Szechwan caves and the Han dynasty graves.

The image of the headless dog is especially interesting. Its tail curls up over the back in true pug fashion. Harness is represented by a collar around the neck and by a belt. These are joined together at the back of the neck by a ring to which, presumably, a rope might be tied. Several similar images having this type of leash have been noted in various collections by the present writer.

Our series includes several fragments of horses' heads and hoofs, most of which are very artistically modeled. (Pl. 1, *a*, No. 341411; pl. 1, *c*, No. 341381.) To judge from these fragments and from other specimens seen in West China, horses of the Szechwan cave period were handsome, spirited animals.

From our twentieth century point of view, none of the Szechwan cave artifacts can possibly be more interesting than the images of human beings. Several of those in the Smithsonian collection represent servants. One fragment shows the hand of a cook resting on

a fish which he is about to prepare for food. (Pl. 5, *b*; No. 345078.) In these figurines servants invariably wear simple hats; some of them have smiling countenances. (Pl. 8, *a*, *c*.)

Another instructive figure is that of a seated man (the head is missing) playing a flute. (Pl. 6; No. 341342.) That this was not the only musical instrument known to the early Chinese is evidenced by a second fragment which shows a hand strumming a lute. (Pl. 5, *a*; No. 342200.) The writer saw one lute of this kind in Suifu in 1930 and there are several on exhibition in the Imperial Museums at Peiping.

That the builders of the Szechwan caves were devotees of the theater is at least suggested by one figure, evidently that of a clown or a comedian. (Pl. 7, *b*; No. 345077.) The left eye is half closed, while the other is wide open. The face is contorted; the mouth is drawn out of shape and the tongue protrudes. A bit of plaster adheres above the right eye, but we find nothing to indicate that the entire face was whitened. On the Chinese stage to-day it is customary for clowns or fun makers to whiten themselves around the eyes, and one is led to wonder if the same custom prevailed in Szechwan nearly 2,000 years ago.

A second possible stage figure is the *niao yah* character, a strange human being having large tusks and a long tongue hanging down his chest. (Pl. 7, *c*; No. 341403.) The Chinese say that this character occurs frequently in local theatricals; that he is very fierce, and that he has been known on the Chinese stage for hundreds if not thousands of years.

Chinese history and literature contain much evidence that the inhabitants of the middle kingdom admired beautiful women. And we may assume that the people who constructed the Szechwan caves were equally discerning, for the cave artifacts include many fragments of female figurines. A number of heads in our collection show undeniable beauty and unquestioned skill on the part of the artist. Some of these heads wear earrings; others have jewels or similar ornaments on their hats, just above the forehead. In most instances, the features are rather dimly indicated, but there is a smile in each case and the eyes and nose are distinctly Mongolian. In this they resemble present-day Chinese women, and according to Chinese standards at least, both grace and beauty are recognized in the figures. All of them portray slender women. (Pl. 7, *a*, No. 341393; pl. 8, *b*, No. 342179; pl. 9, No. 341336.)

A possible exception to this latter statement is the remarkable little head shown in Figure 14 (No. 342199). Like the others, it was molded; unlike the others, it is solid. It is small, measuring only $1\frac{3}{4}$ by $1\frac{1}{4}$ inches. The nose is wide, thick, and low; the chin is

double—the mark of a well-rounded figure. The face wears an engaging smile and dimples lie just beneath the surface. Earrings hang from the ears. But the most interesting thing is that the bangs, indicated by incised lines, are combed straight down over the forehead and clipped off just above the eyebrows. This same style of coiffure—bangs combed straight down—is still very popular among young women and girls in Szechwan Province, and probably all over China. Apparently it has persisted 2,000 years.

Not only do the figurines in the collection before us tell much of character—at least the artist's conception of what character should be—but they also provide information as to the nature of both mas-



FIGURE 14:—Head from a small figurine

culine and feminine dress in the days when the caves of Szechwan Province were under construction. One fragment (No. 341405) shows the method of attaching a sandal. Loops rise from the extreme toe and heel and from each side near the proximal ends of the first and fifth toes; through these loops passes a single cord, supported by a strap across the instep, which is exactly the manner of tying the common straw sandal worn to-day. Here again we have evidence that some customs have changed but little in Szechwan during the last 2,000 years.

Plate 10 (No. 342178) represents a servant with broom and dustpan. The latter closely resembles the bamboo dustpan, or *ts'o gi*, used in almost every Szechwanese home, urban or

rural, at the present time. Farmers often employ large ones, attached to poles, as a means of carrying fertilizer and other stuffs. The resemblance between that on the clay image before us and those in use to-day is so close that there is little doubt that the latter are survivals of an early type of Szechwan dustpan.

A man with hands folded in the wide sleeves of his long gown is shown by the fragment pictures in Plate 11 (No. 342177). Gowns with long, flowing sleeves were in use in China centuries before the Christian era and they are still being worn. It is a common practice in West China to use the ample sleeves as muffs. The hands, folded inside, are comfortably warm even on the coldest winter days.

Most of the clay images in the present collection were made in half molds and joined together while still moist. Externally, the figures

show no retouching except along the sutures, where careless scraping, usually, has removed superfluous clay from the seam. As might readily be expected, the inside in every case is left rough—just as the modeler completed his pressing and gouging. The plastic clay was pressed into the irregularities of the mold; the excess hastily removed with a blunt, flat-faced instrument. There was no attempt at smoothing. It seems not unlikely that, before casting, the molds were first dusted with dry clay.

The "flute player" (pl. 6) and the little head with the double chin (fig. 14) are exceptions to the above statement. Both are solid, not hollow; the former at least was made in a half mold and finished flat at the back.

Among the vessel fragments shown in Plates 12 and 13, use of the potter's wheel is evidenced, we believe, by the continuous striations inside and by the nature of the flat bottoms. We would emphasize, however, that we are not positive these vessels were wheel made.

One of the most common artifacts in the Szechwan caves is the earthenware coffin. It has often been found in place, sometimes containing human bones. More frequently broken pieces of the coffins can be seen strewn over the floors of the caves. Almost all the caves have coffin niches, but in some cases the coffins are merely cavities chiseled in the stone and fitted with stone lids. Some caves have places for several coffins, indicating that they were used by families. Two coffins are sometimes found side by side, evidently for the burial of a man and his wife.

We have already referred to the fact that there are collections of artifacts from Chinese Han dynasty graves in the Field Museum, in the public museum at Chengtu, and in the Imperial Museums at Peiping. The objects in these collections so closely resemble those herein described that one can scarcely avoid the conclusion that the "mantsu" caves of Szechwan Province are really Chinese tombs made during the Han dynasty and possibly during the early years of the Three Kingdoms. This conclusion is emphasized by the fact that many of the carvings and artifacts reflect customs or represent implements that were in use by the Chinese 2,000 years ago, many of which have persisted until the present day. The "mantsu" caves, with their characteristic contents and ornamentation, seem very much at home in the Chinese culture but in a strange world among the aborigines of West China. We know of no primitive tribe that now makes and uses artificial caves or artifacts such as those found in Szechwan Province. Further, the Rev. Thomas Torrance has informed the writer that on top of a hill on the edge of the Chengtu plain, typical graves of the Han dynasty period occur, while along the sides of the same hill Szechwan caves may be seen.

and that in form of construction and nature of contents the two are alike.

While Chinese inscriptions are rare in the caves of Szechwan, there are Chinese characters in one cave recording the joint ownership by two Chinese, and in another giving the date of the cave as 103 A. D.⁶ Moreover, Han dynasty coins are found in previously undisturbed caves.⁷ The above facts indicate that the caves can not possibly antedate the Chinese.

The burial customs of the Chinese have had a long history and evolution. In the earliest times men and women were killed and buried with their dead leaders so that their souls might accompany those of the deceased and serve them in the land of shades. The history of the Cheo dynasty (B. C. 1122-255) gives several instances when the living were buried with the dead, a custom probably confined to the upper strata of society. We note in this history (ninth book, sec. 33, p. 4) that when the emperor, Ch'i Huang Gong, was buried, his two wives and many others in the palace were interred with him, a total of several hundred people. Again, in an account of the death of Chin Muh Gong (twelfth book, sec. 47, p. 16), it states that 177 people, in addition to three high officials, were buried with him and that the populace sorrowed because of the death of these three nobles. A third instance (fourteenth book, ch. 55, p. 19) tells of an official who ordered that his favorite wife should be killed and buried with him, but whose sons refused to carry out his instructions. In book 18 (ch. 70, p. 12) we read of an emperor who took refuge in the home of a farmer after being defeated in a revolution. The farmer, with traditional hospitality, presented his two daughters as wives for the Emperor. But even this magnanimous gesture did not conquer his melancholy. When he hanged himself shortly thereafter the two women were killed and buried with him.

Farther on in the history (nineteenth book, sec. 75, pp. 19-20) we read the sad story of King Wu, who had a daughter whom he loved dearly. As evidence of his deep affection, it was his custom to divide any good food he had, sending half to his daughter. She misunderstood this, thinking he was esteeming her lightly and giving her only the remnants from his table. Humiliated, she committed suicide. In preparing for her burial, the King ordered the construction of an artificial pond in the center of which, on a little island, he placed the grave, surrounded by a wall. A tunnel led from the mainland, under water, to the grave. People gathered out of curiosity to witness the funeral, and when some of them went

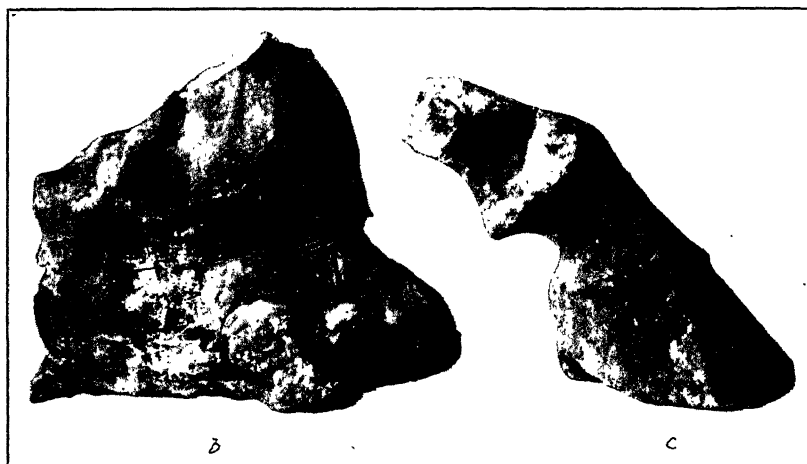
⁶ Journal, North-China Branch of the Royal Asiatic Society, vol. 41, pp. 68-69, Shanghai, 1910.

⁷ Ibid., p. 69.

into the passage, the King had them shut in and allowed them to perish there so they would accompany his daughter into hades and there be her servants.

These, and other instances that could be mentioned, show that in China, as in other parts of the world at a much later date, it was customary between two and three thousand years ago to kill and bury human beings with kings, nobles, and others of the upper class. With them were also buried fowls, dogs, weapons, jewelry, money, and other objects. At a later date images of wood and straw were substituted for the living. During the Han dynasty unglazed burnt-clay images were used. By the time of the Tang dynasty (A. D. 620-907) the images were generally glazed. People had also begun to burn paper money (it was believed that burning transformed it into real money that could be used by the departed souls in hades) instead of placing actual coins in the tombs. This custom of substitution spread until it included all the diverse offerings, animate and inanimate, formerly interred with the deceased. Burials in the Szechwan caves were accompanied by clay images which differ in no appreciable degree from those found elsewhere in Chinese tombs of the Han dynasty and of the Three Kingdoms. For these reasons it seems quite evident that the Szechwan caves are of Chinese origin and that they can not be earlier than the Han dynasty.

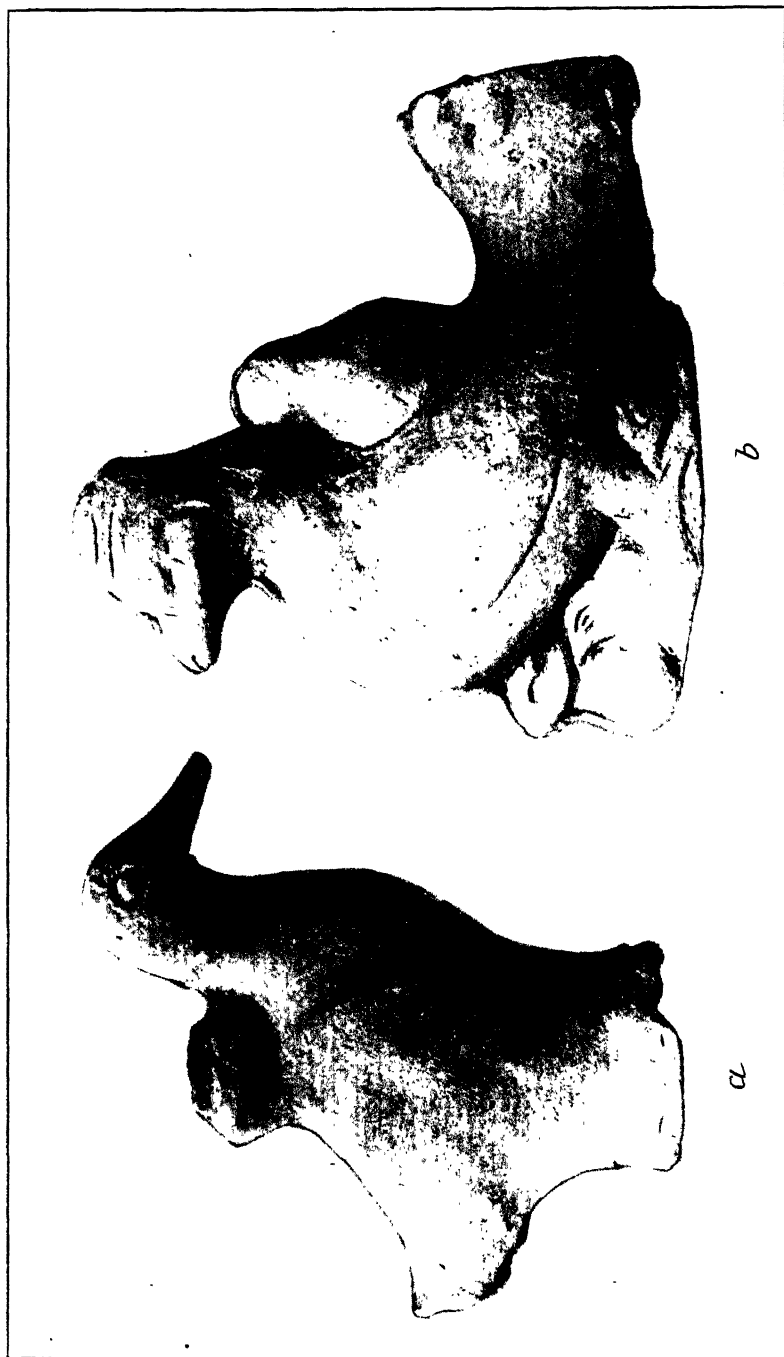
In China to-day paper money and paper images of people, domestic animals, houses, and many other things are burned during the funeral ceremonies. It is believed that, through burning, these paper figures are transformed into real people, houses, money, etc., for use of the departed souls. Chinese widows rarely remarry, for the simple reason that they hope after death to rejoin their late husbands in the other world.



FRAGMENTS OF A HORSE'S HEAD, AN ELEPHANT'S FOOT, AND A HORSE'S
FOOT



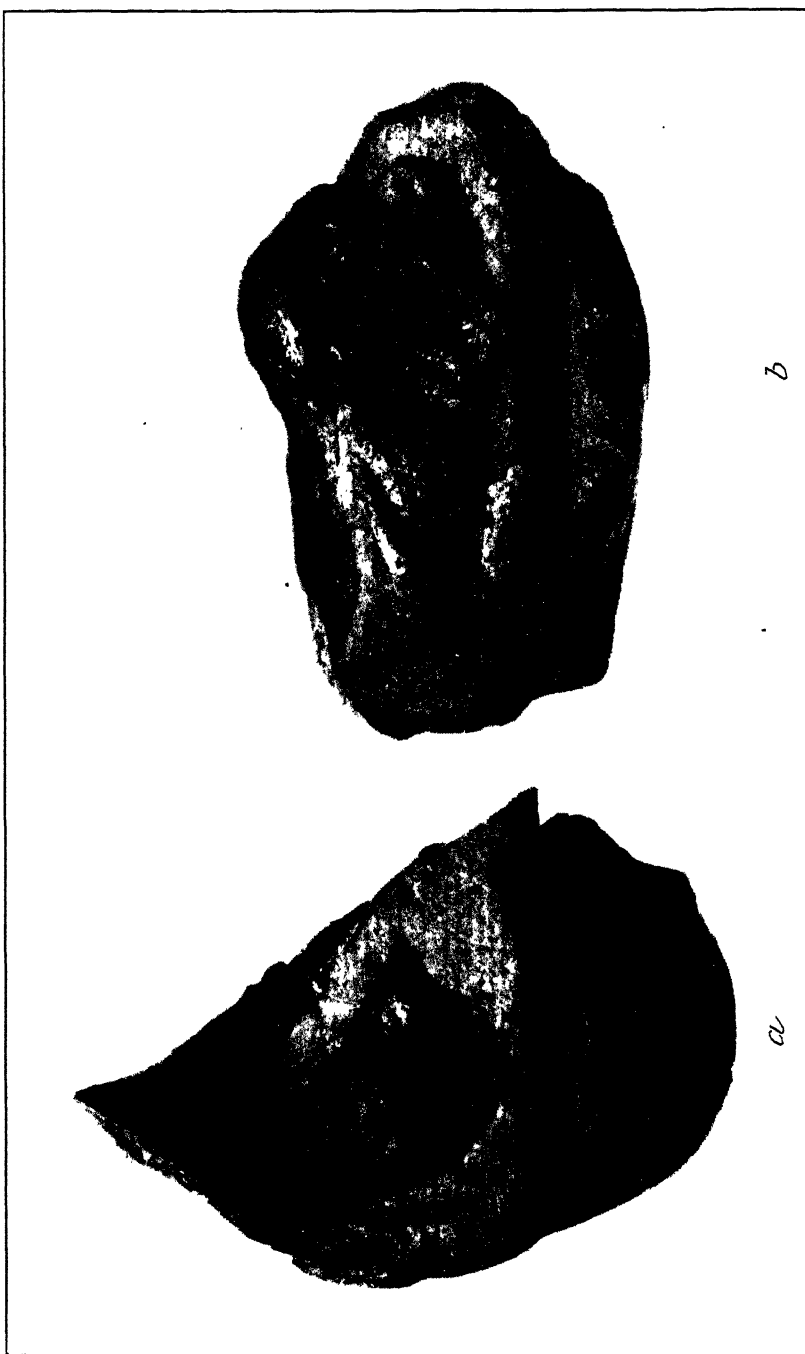
FRAGMENTS OF A CLAY BOTTLE AND A BELL



CLAY IMAGES OF BARNYARD FOWLS



FRAGMENTS OF DOG EFFIGIES



HAND RESTING ON (a) LUTE AND (b) FISH



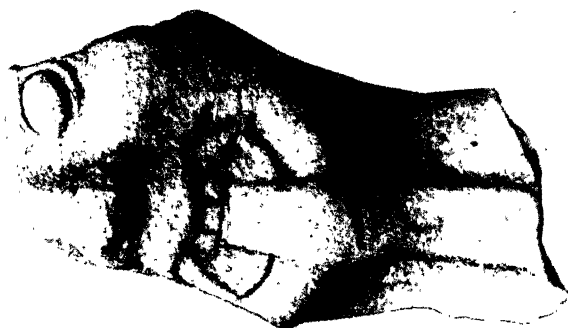
FIGURE OF A MAN PLAYING A FLUTE



a



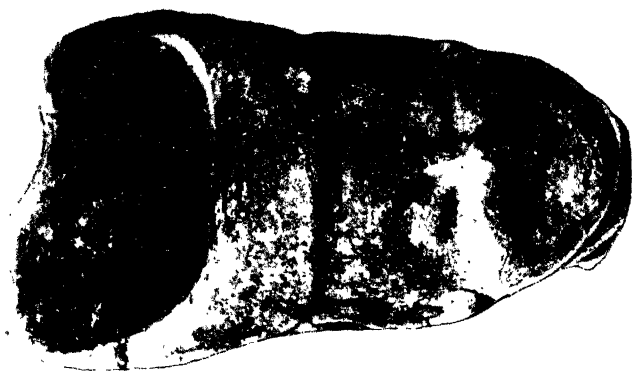
b



c

HEADS FROM CLAY FIGURES

a, woman; *b*, clown; and *c*, a nao-yah character.



HEADS FROM CLAY FIGURES
a and *c*, male servants; *b*, a woman.



HEAD FROM THE CLAY IMAGE OF A WOMAN



SERVANT WITH BROOM AND DUSTPAN



FRAGMENT OF A MALE FIGURE WITH HANDS IN SLEEVES

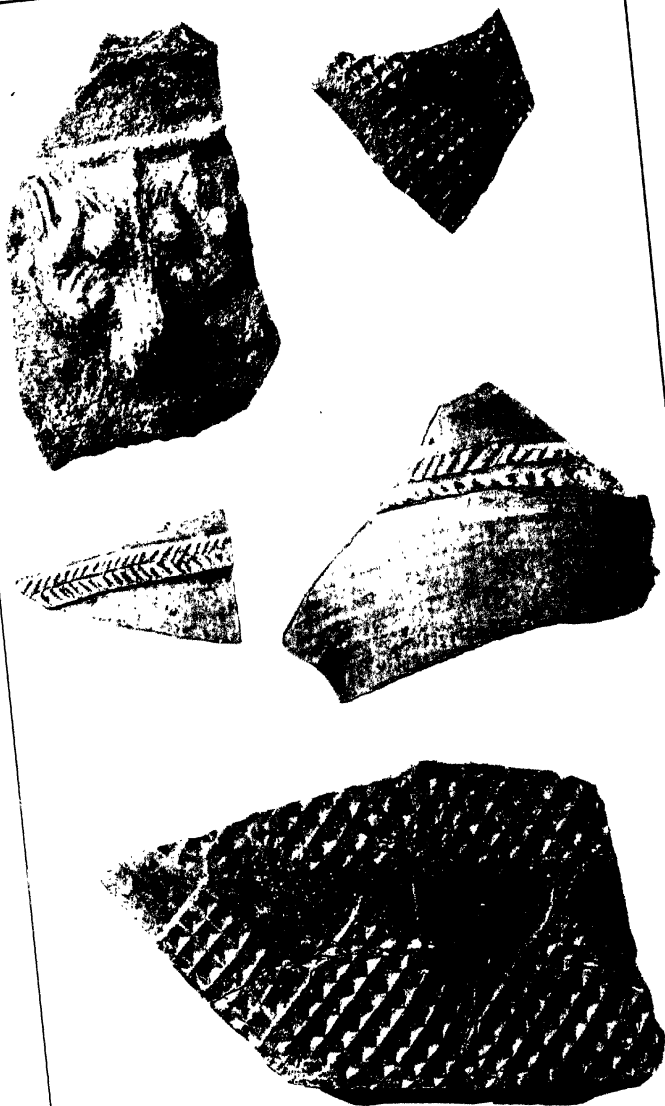


a



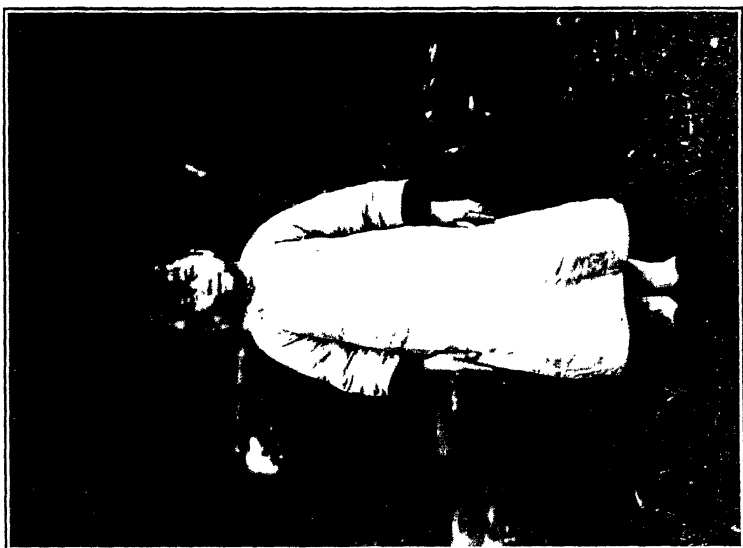
b

FRAGMENTS OF EARTHENWARE VESSELS

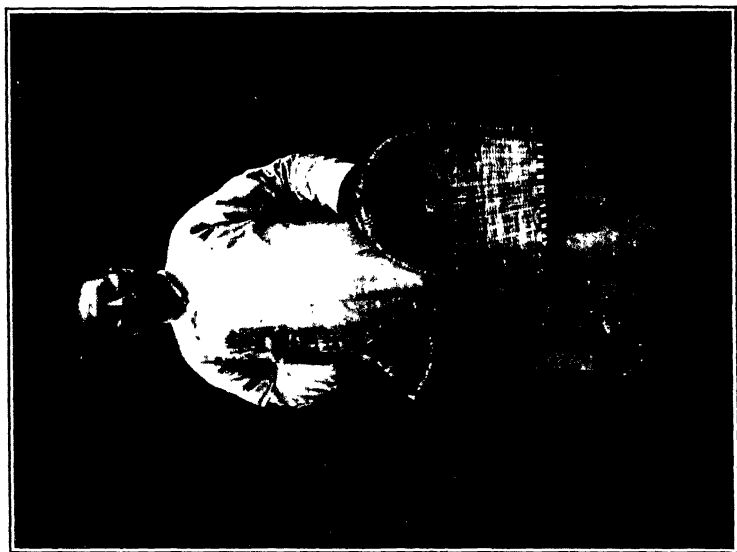


SHARDS SHOWING TYPE OF DECORATION



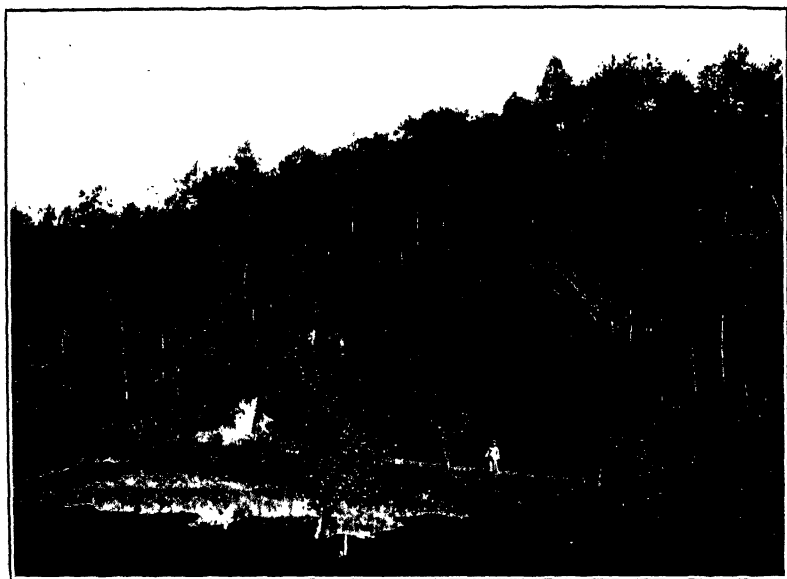


b, A girl of Szechwan Province

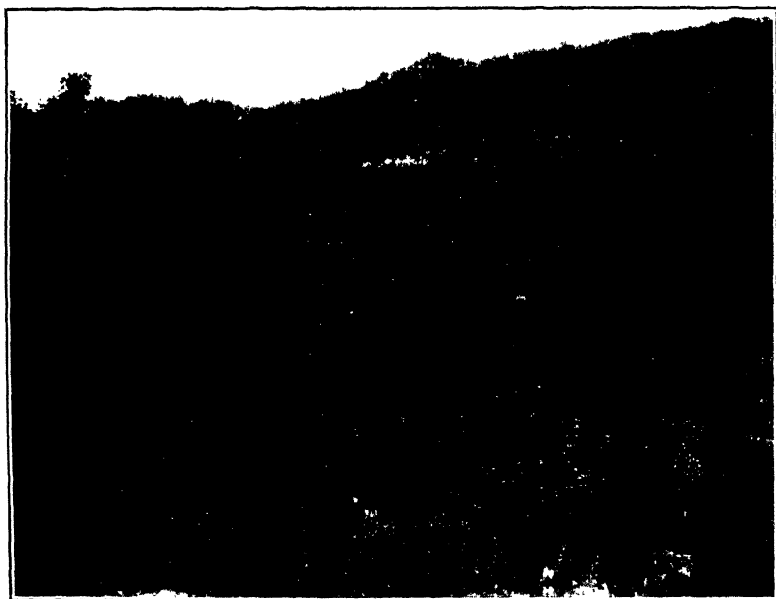


a, A male servant

MODERN CHINESE COSTUMES



a, Near Kiating



b, Near Huang Sha Ch'i, Szechwan Province

ANCIENT CHINESE CAVE TOMBS

A NEW MARINE SHELL OF THE GENUS *XENOPHORA* FROM FLORIDA

By PAUL BARTSCH

*Curator, Division of Mollusks and Cenozoic Invertebrates
United States National Museum*

During the summer of 1931, Dr. William H. Longley, executive officer of the Marine Biological Laboratory of the Carnegie Institution at the Tortugas, Fla., made a number of deep-sea dredge hauls south of Loggerhead Key. In one of these hauls two large living *Xenophora* were obtained in 98 to 125 fathoms of water, which prove to belong to an undescribed species, which I take pleasure in naming for Doctor Longley.

XENOPHORA LONGLEYI, new species

PLATE 1

Shell unusually large for the genus. The type has about 8 whorls; as the apex is somewhat fractured, the exact number is slightly in doubt. The shell is of grayish-white coloration. The whorls are broadly conic and overhanging, particularly so in the later turns, where, for example, in the last whorl a very broad peripheral fold extends obliquely outward. The basal portion of the turns is more or less ornamented with fragments of attached shells, in this instance rather less so than is usual in the genus. The actual sculpture on the upper side of the turns consists of retractively curved, irregular, incremental lines, which lend a somewhat wavy appearance to the shell. There are also wavy, closely spaced, fine, threadlike elements placed at right angles to the incremental lines, which give to the surface a decidedly ripple-marked effect. The periphery of the last whorl has a decided curtainlike flap, to which I have alluded above. The basal side of this flap is smooth and porcelainous white, while the rest of the base has a reddish tinge, but here and there it shows an indication of the incremental lines. The base of the shell is moderately openly umbilicated. The basal wall is moderately convex and is marked

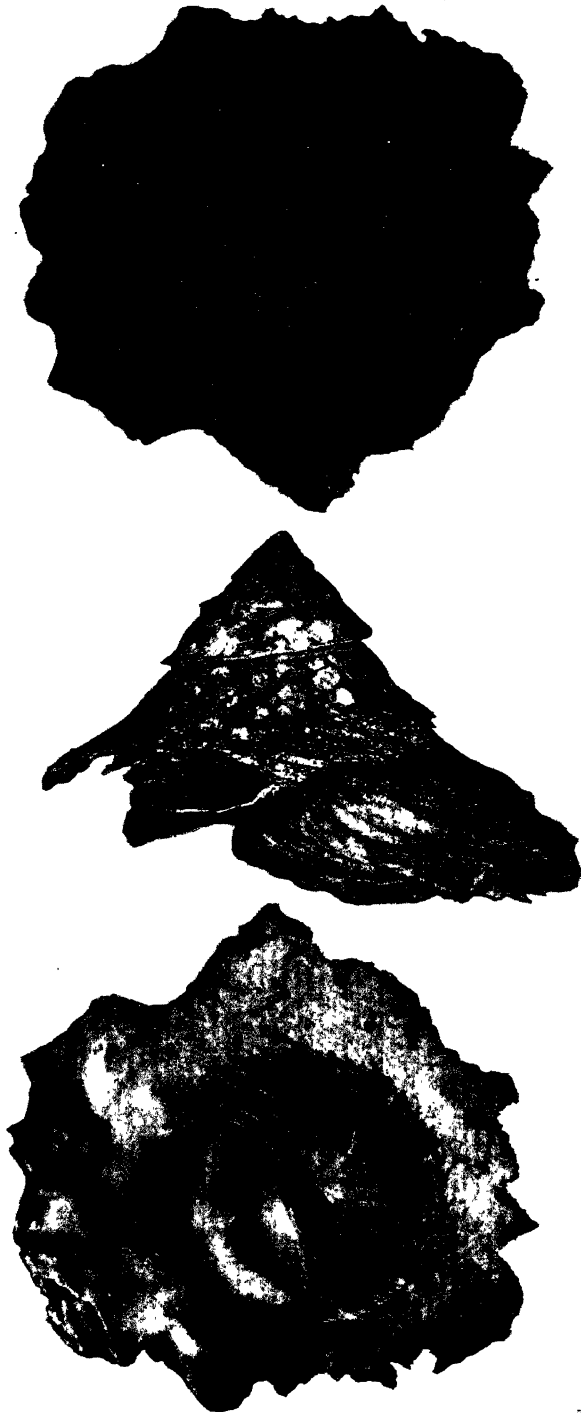
by rather strong, sublamellar, retractively curved, riblike elements, which join the outer peripheral flap in a series of slender buttresses. In addition to this, the base is marked by fine, irregularly placed, spiral lirations. The aperture is of irregular shape. The basal lip is decidedly sigmoid, forming an even, concave curve from the flap to the columella. The parietal wall is covered with a glazed callus, while the outer lip is constituted by the continuation of the broad parietal flap.

Type.—U.S.N.M. No. 382689 measures: Altitude, 85 mm.; greatest diameter, 144 mm. The topotype is entered as U.S.N.M. No. 382690.

Remarks.—U.S.N.M. No. 92922 contains four badly worn and battered specimens dredged in 1885 by the United States Bureau of Fisheries steamer *Albatross* at Station 2625 in 247 fathoms on gray sand bottom; bottom temperature, 46° F.; 75 miles south by east, ½ east off Cape Fear, N. C. These specimens in the past were referred, probably on account of their poor condition, to *Xenophora caribaea* Petit, but they are in reality members of the present species.

The present species differs from *Xenophora caribaea* Petit in being much larger, less ornamented with borrowed shells, and much more closely sculptured with much more overhanging whorls, but the greatest distinguishing characteristics are in the basal portion of the turn, which in *X. caribaea* has a spiral keel immediately within the junction of the peripheral flap and in the basal wall, which is absent in the present species. *X. caribaea* lacks the expanded riblets of the base, which extend as buttresses on the flap in the present species.

From *Xenophora conchyliophora* Born, the only other Floridian *Xenophora*, the present species differs by having the broad peripheral flap, which is missing in *X. conchyliophora*. Here, too, the base is not umbilicated and entirely differently sculptured.



XENOPHORA LONGLEYI. NEW SPECIES

THE PARASITIC HABIT IN THE DUCKS, A THEORETICAL CONSIDERATION

By HERBERT FRIEDMANN,

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It has been well known for many years that a number of kinds of waterfowl are rather careless in their egg-laying habits, not infrequently laying one or more eggs in a near-by nest of another bird of the same or other species, but still caring for their own nests and eggs. Thus, among North American birds, some of the grebes, the great auk, certain of the auklets and murrelets, a number of gulls and terns, pelicans, ducks, rails, herons, a few shore birds, and others have been known to drop an occasional egg in another bird's nest. Gallinaceous, picarian, and passerine birds have been known to act in a similar fashion at times, and I have such records for not fewer than 54 species of North American birds, not counting the regularly parasitical cowbirds. Years ago Paul Leverkühn compiled a great mass of data on this and allied topics in his book *Fremde Eier im Nest: Ein Beitrag zur Biologie der Vögel* (Strange Eggs in the Nest: A Contribution to the Biology of Birds), published in 1891. Since the publication of this work a still greater mass of data has been put on record, while other writers, such as Swynnerton,¹ have attacked the problem of rejections by birds of eggs unlike their own.

Among all the groups of birds involved, the habit is met with most frequently in the Anatidae. The literature is so full of records that a few quotations may here be sufficient. Shepardson² writes that waterfowl are addicted to this carelessness, " * * * many species leaving their eggs to the care of other birds. Thus the eggs of the Ruddy Duck, the Redhead, the Shoveller, and others are frequently found in the nests of other ducks and coots." Job³ found " * * * nests of Gadwall, Baldpate, and Scaup that had each 1 or 2

¹ *Ibis*, 1918, pp. 127-154.

² *Condor*, vol. 17, p. 100, 1915.

³ Among the wild fowl, p. 201, 1902.

Scoter's eggs in them, and that these first three also intermingled with one another." He calls the ruddy duck, the most given to the habit, "semiparasitic." Bent⁴ notes that the redhead and the canvasback " * * * have a peculiar habit of building what we called dumping nests in which large numbers of eggs are deposited but apparently not incubated; we found two such nests, one of which contained 19 eggs, 9 of the Redhead and 10 of the Canvas-back piled up indiscriminately and some of them had rolled out of the nest which was partially broken down and evidently deserted." In another place⁵ the same author writes that the redhead " * * * seems to be particularly careless about laying its eggs in other ducks' nests. We found one of its eggs in a Ruddy Duck's nest * * * and in three cases found from three to four of its eggs in nests of the Canvasback. * * * All the Canvasbacks' nests that we found contained one or more eggs of the Ruddy Duck or Redhead * * *." Job⁶ found " * * * Red-head's eggs in a Canvas-back's nest, Ruddy's twice in a Red-head's, Lesser Scaup's in a Shoveller's, and * * * Shoveller's eggs in the nest of a Baldpate." The ruddy duck has also been known to deposit its eggs in nests of grebes and bitterns, while the Canada goose has been recorded laying an egg in an osprey's nest, and the osprey was seen to incubate the egg.⁷

In view of the widespread tendency among the ducks to drop an occasional egg in another bird's nest, it was no great surprise when it was discovered that the Argentine black-headed duck (*Heteronetta atricapilla*) was regularly and entirely parasitic in its reproductive activities. This remarkable duck, rather closely allied to the ruddy duck, has been found by Daguerre, Wilson, and others to be parasitic on coots, ducks, limpkins, and other birds, and its eggs have been found in a hawk's nest as well. Phillips⁸ has summarized these data as follows:

It is very extraordinary that no nest of this species has ever been found, or at any rate described. This gap in our knowledge of the bird's life-history may be due to the fact that the species is extraordinarily parasitic, depositing its eggs in the nests of such birds as the Coscoroba Swan (*Coscoroba*), the Crested Screamer (*Chauna*), the South American Limpkin (*Aramus*), Gulls (*Larus*), Coots (*Fulica*), White-faced Ibises (*Plegadis*), Black Rails (*Pardirallus*), and even the nests of the Chimango, or Southern Caracara Hawk (*Milvago chimango*). Ducks' eggs found in such situations were at first attributed to the Rosy-billed Duck * * * but a later writer (Daguerre * * *) has discovered that these parasitic eggs are slightly different from those of the Rosy-bill, being more whitish and the surface very finely granulated; they are also thicker and more blunt. Most convincing is his statement that these sup-

⁴ Auk, vol. 24, p. 422, 1907.

⁵ Auk, vol. 19, p. 9, 1902.

⁶ Auk, vol. 16, p. 165, 1899.

⁷ Fennin, Auk, vol. 11, p. 322, 1894.

⁸ Natural history of the ducks, vol. 3, p. 96, 1925.

posed Rosy-bill eggs are identical with a mature egg which was taken from the oviduct of a female of the Black-headed Duck. It may be remarked in this connection that the Black-headed Ducks are not uncommonly seen in the company of Coots.

Since the time this was published, a few additional data have been forthcoming, all of which tend to show that *Heteronetta* is regularly parasitic in its breeding habits. It lays a relatively large egg for its size, usually larger than the eggs among which its own are deposited.

Of all the nonparasitic forms, the ruddy ducks (*Erismatura* or *Oxyura*) are certainly the most frequent offenders, and it is of great interest and suggestive value that, for their body size, they lay the largest eggs of any of the ducks except *Heteronetta*, which lays a similarly large egg. At first sight it might seem that the large size of the eggs, as compared with the smaller ones of the other ducks in whose nests they are laid, is a factor directly correlated with the relatively greater frequency of parasitism in the ruddy ducks, paralleling in a way the case of the cowbirds parasitizing birds smaller than themselves; but while the facts are perfectly sound, the correlation appears to be only an indirect one. Ruddy ducks are notoriously shy at their nests; this is true not only of the North American species *Erismatura jamaicensis*, but of the Old World forms as well. In fact, so marked is this trait in the Palearctic *Erismatura leucocephala* that there are many stories to the effect that the bird sits on the eggs for a few days only, and that after the embryos have gotten well started in their development the parent ceases incubation entirely and actually does not even revisit the nest.

Phillips* writes that *leucocephala* occasionally uses old nests of coots, thus sometimes not building for itself. Of the North American ruddy duck he records some very significant facts. The birds do not mate early, or, at least, often not until after reaching their breeding grounds. Some of the nests are—

* * * very poorly constructed and in some cases the eggs have actually been found wet in a carelessly made nest * * *.

Another curious thing about the Ruddy is that not all the eggs found are in the same stage of incubation and it is certain that the females lay more or less in each others' nest, for their nests are often rather close together * * *.

As a general thing so shy is the female that she is never seen near the nest at all, even when the eggs are well along in incubation * * *.

* * * The male retains some little pride in his own or other families (we hardly know which) and is seen with the young broods until they are a third or half grown, behaving in a most gallant fashion, displaying on any or every occasion and rushing at real or imaginary intruders with a great show of jealousy. He is therefore wholly an exception to any other North American duck (excepting only the Tree Ducks) for he goes into molt much later than any other species and spends the summer parading about in the full glory of his rich, red plumage.

* Natural history of the ducks, vol. 4, p. 156, 1926.

Another bird allied to the ruddy ducks, the African white-backed duck (*Thalassornis leuconotus*), is similarly shy about the nest, and the egg is similarly large in size.

When a species begins to show a loss of some of the instinctive behavior usually exhibited by the female, one is led to wonder if it may not be becoming what Riddle and others might call a "male species," that is, one in which the females are more malelike and the males "normally" masculine. It is of great interest to find, then, that Wetmore¹⁰ observed that the female ruddy ducks very commonly mimic the males in display postures and even make a rattling noise with their bills against their cheeks. He noted that this was given at times by females that were apparently unmated. This suggests a latent form of maleness in the females, and I suspect that in these individuals this type of homosexual urge was stronger than in most, and that they were not displaying because they were unmated but were unmated because they were displaying.

In the tree ducks (*Dendrocygna*) the males take some part, if not the major part, in the incubation of the eggs. Shields¹¹ found the fulvous tree duck (*Dendrocygna bicolor*) to be occasionally parasitic. Another species, *Dendrocygna javanica*, is known to make use of old nests of cormorants, kites, and crows very frequently. Another instance of increasing "maleness" in the female is shown by the New Zealand sheldrake, *Casarca variegata*. Of this duck Phillips¹² writes as follows:

It is a very interesting fact that the female is very forward, very active and very amatory, while the male assumes a rather passive rôle. Taken in connection with the fact that the young resemble the male, and that the female plumage is so different and perhaps the result of more recent specialization, the relation of the sexes would well repay further investigation * * *.

All Sheldrakes are prodigious fighters, at least during the breeding season, but this species leads them all in strength and combativeness * * *. Here again the female takes the initiative, egging her mate on with loud calls and excited movements.

For our immediate purpose, however, it is sufficient to know that the females of the ruddy duck are not so "feminine" in their breeding behavior as what we are accustomed to consider "normal," or, to use a better term, usual, in ducks. This diminution of the care of the eggs, coupled with the high frequency of carelessness with regard to the nest in which they lay them, opens the path to parasitism as a regular, well-established habit.

Even if we grant the above conditions, the parasitic habit could not become successfully established unless the eggs laid in strange nests materialized into young birds. If they did not, then all this care-

¹⁰ Auk, vol. 37, p. 247, 1920.

¹¹ Bull. Cooper Orn. Club, vol. 1, pp. 9-11, 1899.

¹² Natural history of the ducks, vol. 1, p. 253, 1922.

lessness would only result in a form of check upon the increase of the species population. The fact that the female ruddy ducks seem to incubate but little after the first few days suggests that their eggs may have a higher viability than most, or may be able to keep on developing under rather adverse conditions. If this were so, then the eggs laid at random in other birds' nests might well survive even if only incubated a little now and then. It is therefore of pertinent interest to find that such is definitely the case in the European ruddy duck (*Erismatura leucocephala*). Henke¹³ took some eggs of this duck, and, after putting them in a bowl at room temperature, found that they kept as warm as if they had been incubated. Not only was slight cooling, such as room temperature, ineffective in harming them, but extreme heat was likewise survived by the embryos. By accident Henke left the eggs on a warm stove for some hours, and then removed them, and after a week he was agreeably surprised to see the eggs hatch. Apparently they were not injured by the stove heat, but still the heat was probably considerably more than that of ordinary incubation. This experiment, while crude and still unchecked, serves to indicate the high degree of probability of ruddy ducks' eggs surviving rather untoward conditions.

Recently Meyer and Stresemann¹⁴ have suggested that megapodes' eggs and ruddy ducks' eggs hatch by virtue of the heat they retain or generate themselves after the first few days of embryonic development. The notion that the heat is supplied the megapodes' eggs by the fermentation and decay of the vegetable matter in the mound is thought to be questionable; the mound may serve merely to prevent the loss of heat from the eggs after the first few days, when the eggs do actually receive heat from the mound or sun. As far as I know, there is no positive evidence in favor of these eggs possessing any mechanical or structural peculiarity in their thermal adjustments not found in eggs of other birds, but the facts of their incubation seem quite well founded.

It seems, from the above, that in the ducks there is a tendency to drop an occasional egg in another nest; this tendency becomes more pronounced in some species, and reaches its climax in the ruddy ducks and their near allies, and its very pinnacle in the parasitic *Heteronetta*. With the growth of this tendency is correlated an independent factor, namely, the heat-retaining, or perhaps heat-generating, properties of the eggs. Thus it may be that the so-called "dumping nests" of the redhead and canvasback, mentioned by Bent, are extra nests of birds that have lost some of the single-nest limitations and contain eggs that have been partially incubated and that are left to their own heat resources. Whether the eggs

¹³ Zool. Garten, vol. 21, pp. 142-147, 1880.

¹⁴ Orn. Monatsb., vol. 36, pp. 65-71, 1928.

of the redhead and canvasback are able to meet such a situation is immaterial; the fact that such a habit is practiced indicates that it may well be expected in the ruddy ducks as well, and probably was a stage in the development of the present parasitic habit of the black-headed duck of Argentina. In the ruddy ducks the eggs seem to be able to meet such a thermal situation. The large size of these eggs is possibly correlated with their heat-adapting abilities, and may therefore be an indirect correlative of the parasitic habit. It has not yet been demonstrated whether the eggs of *Heteronetta* also possess these thermal abilities; there are two alternatives to be here considered. If the eggs of this duck are heat adaptive, their survival in strange nests is easily accounted for, as the victims undoubtedly do take care of them to some extent. If they are not heat adaptive, then the parasitic habit is the sole cause for the survival of the species, for if eggs unable to cope with thermal difficulties are laid in nests where they are uncared for, as in the "dumping" nests, the chances are all against their survival. If, however, they are laid in nests where they are given incubation by some other bird, they will have a good chance to hatch out. Therefore, if the eggs of *Heteronetta* are not thermally adaptive, the fact that they are laid in cared-for nests is the secret of their survival. If they are able to cope successfully with the thermal difficulties attendant on the lack of regular incubation, then the parasitic habit is due merely to the loss of the nest-building instinct, as the eggs would get along in uncared-for nests just as well as in others where they receive incubation. If the eggs were laid in uncared-for nests, that is, old or abandoned nests, the birds could hardly be called parasitic. Whichever of these two possibilities is correct, however, the fact remains that *Heteronetta* appears to have lost the nest-building habit. The problem of the parasitic habit then must be considered unsettled until this angle is delved into more fully.

We have seen that the ruddy duck sometimes uses old nests of coots; at other times it builds very poor nests; we have seen, incidentally, that the concept of territory is not well maintained, as the nests are often close together; the mere fact that females with nests of their own lay in one another's nests shows how poorly established are the territorial limitations of the actions of the individual birds. The diminution of the territorial and nest-building instincts are seemingly correlated with the diminution of incubating activity on the part of the female parent; if the bird comes to the nest relatively little, it follows that it will not be apt to respect its territorial boundaries as much as a bird with a strong instinctive attachment (through incubation) to the nest. In the case of ducks the territory as such vanishes after the eggs hatch, as the parents take their offspring into

the water, and from then on any place is home to them. Hence the territory lasts only as long as the incubation activities of the parents. Thus it seems that the cause of the diminution of the potency of territorialism is dependent on the lessening of the incubation activities. Inasmuch as the lessening of incubation is merely a step in the path toward a complete lack of incubation, such as in the case of those eggs laid in strange nests (that is, lack of incubation on the part of the bird that laid the eggs), it follows that as this diminishes, approaching zero as a limit, so too the territory as such becomes less and less real and finally vanishes. In an analysis of the cyclical instincts of birds during the reproductive period, the nest is merely something constructed within a territory for the purpose of being a receptacle for the eggs that are to come. Therefore, with the disappearance of the territory as such, there must inevitably come about a loss of the nest-building instinct. It is impossible to construct something in a nonexistent space. Hence it follows that the loss of the nest-building instinct is also dependent on the decrease in the amount of incubation given the eggs by the female parents. Furthermore, to carry this idea a little further, it appears that the origin of the parasitic habit in the Anatidae is bound up with the heat adaptability of the eggs of the ruddy and black-headed ducks. If their eggs did not have this peculiarity, any lessening of incubation would have resulted in the extermination of the species; the fact (?) that they have, has allowed for the development of parasitism in this group of birds.

A REVIEW OF THE NEMATODES OF THE GENUS HASTOSPICULUM, WITH DESCRIPTIONS OF TWO NEW SPECIES

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The genus *Hastospiculum* was proposed by Skrjabin (1923) for a filarid (*H. varani*) found underneath the peritoneal lining of a lizard (*Varanus griseus*). To this genus Yorke and Maplestone (1926) added a second species (*H. gouldi*), from *Varanus gouldi*; and Chandler (1929) added a third (*H. spinigerum*), from *Varanus flavescens*, and pointed out that *Filaria bipinnata* von Linstow probably also belongs to *Hastospiculum*. Baylis (1930) redescribed *Filaria macrophallos* Parona as a member of this genus.

In the present paper two new species of *Hastospiculum* are described. The first was collected by Dr. E. W. Price on October 14, 1929, from a python (*Python reticulatus*), which died in the National Zoological Park, and the second was taken by the writer from two specimens of a boa (*Constrictor imperator*), which died in the same park on January 19, 1931, and February 12, 1931, respectively. In addition, *H. spinigerum* Chandler is herein redescribed, and brief descriptions of the other species of the genus are brought together into a form in which comparisons can be made. As Baylis points out, some of the species may be synonyms, but until further information can be obtained they must be regarded as valid species.

HASTOSPICULUM SETIFERUM, new species

PLATE 1, FIGURES 1-4

Description.—*Hastospiculum*: The mouth opening is elongate dorsoventrally and surrounded by a raised, thickened region of the cuticle. A pair of blunt, lateral, liplike projections arise from the outer surface of the cuticular elevation, each of which bears at its base a single inward-projecting process. The external manifestations of the amphids, or so-called lateral papillae, are small round pores around which the surface is perceptibly elevated. They are

located farther posteriorly than the above-mentioned lips and are situated nearly in the same circle with eight submedian papillae. The esophagus is divided into an anterior, short, muscular portion, about 610μ in length, and a posterior, wide, less muscular portion of which the exact length was not determined because of the opacity of the specimens. The nerve ring surrounds the posterior fourth of the anterior part of the esophagus in both sexes.

Male, 75 mm. long by 550μ wide, the diameter practically uniform throughout. The cuticle is finely striated, but not annulated as in the female. Testis single, reflexed; tail surrounded by a cuticular expansion in the form of a pair of alae supported by four pairs of preanal papillae and one pair of postanal papillae. There are three pairs of sessile, cone-shaped, subventral papillae near the end of the tail; the tail is cone-shaped and bears minute denticles. The spicules are unequal, the left one being 2.35 mm. long by 12.5μ in diameter, and the right one 280μ long and 52μ in maximum width.

Female, 520 mm. to 540 mm. long and 1.8 mm. to 2 mm. in maximum diameter. Both extremities are bluntly rounded, the posterior being slightly more attenuated than the anterior. The cuticle is marked by fine striations, as well as by irregular annulations, which fuse with one another and do not extend completely around the body. The vulva is situated 800μ from the anterior end of the body. There are two ovaries; the anterior one twists about the intestine and esophagus, while the posterior one extends nearly to the end of the body. The anus is apparently atrophied. The uterus is filled with embryonated eggs, which are nearly spherical and are 80μ long by 69μ wide.

Host.—*Python reticulatus* (Schneider).

Location.—Under the peritoneum.

Distribution.—National Zoological Park, Washington, D. C.

Type specimens.—U. S. N. M. Helm. Coll. No. 29265; paratypes, No. 30767.

HASTOSPICULUM ONCHOCERCUM, new species

PLATE 2

Description.—*Hastospiculum*: Mouth opening surrounded by a cuticular elevation as in *H. setiferum*, but elevation not set off so distinctly dorsally and ventrally as in the foregoing species. The blunt, paired, lateral, liplike projections, which arise from the outer margin of the elevation, are quite square. The subcuticular tissues form a structure that might be likened to an epaulette. The amphids, which are prominent, open in the distal portion of the lateral projections of the "epaulette." Eight submedian papillae are present; the four external submedian papillae have their bases in the dorsal

and ventral projections of the "epaulettes," while the four internal submedian papillae are distinctly set off from them. The cuticle is marked in both sexes with coarse elevations or annulations, which do not pass completely around the body but join one another to form a network. Finer intra-annular striations are also present. The annulations are most marked in the mid-region of the body, becoming less conspicuous at the posterior end and often disappearing near the head.

Male, 38 mm. to 55 mm. long and 500μ to 600μ in maximum diameter. The nerve ring surrounds the esophagus 80μ to 100μ from the anterior end of the body. The anterior muscular portion of the esophagus is 380μ to 420μ in length and has a maximum diameter of 60μ to 120μ . The posterior portion of the esophagus is 7.4 mm. to 8.8 mm. in length and has a maximum diameter of 260μ to 390μ . Testis single, reflexed. Tail surrounded by a bursalike pair of alae supported by five pairs of pedunculate papillae, four pairs of which are preanal and one pair postanal. There are also two pairs of smaller sublateral papillae slightly anterior to a pair of ventral cone-shaped ones. The latter are situated very slightly anterior to the tip of the tail, which is rounded and does not bear denticles. The left spicule is 1.84 mm. to 2.2 mm. long, its proximal portion being wider (20μ wide) than the distal portion, from which it is set off by a slight twist at a point 400μ to 480μ from the proximal end; the distal portion is delicately filiform and about 12μ wide, and terminates in an exceedingly fine point. The right spicule is short and curved, 240μ to 280μ long, and about 20μ in maximum width.

Female, 170 mm. to 350 mm. long and 2.4 mm. to 2.8 mm. in maximum diameter. The nerve ring surrounds the esophagus approximately 280μ from the anterior end of the body. The muscular portion of the esophagus is 600μ to 650μ long and has a maximum diameter of 120μ to 160μ . The posterior part of the esophagus is 15 mm. to 18 mm. long and 500μ to 600μ wide. The anus is apparently atrophied. The tail is bluntly rounded. The vulva is located posterior to the base of the muscular portion of the esophagus, 850μ to 1 mm. from the anterior end of the body. Eggs embryonated, spherical, and 44μ to 48μ long by 40μ to 44μ wide; shell simple.

Host.—*Constrictor imperator* (Daudin).

Location.—Under the peritoneal covering of the stomach and intestine.

Distribution.—National Zoological Park, Washington, D. C.

Type specimens.—U. S. N. M. Helm. Coll. No. 30759; paratypes, No. 30740.

HASTOSPICULUM VARANI Skrjabin, 1923

PLATE 3, FIGURES 6, 7

Description.—*Hastospiculum*: Large filarids characterized by a special ornamentation of the head; mouth oval, bearing on each side a distinct lip arising from a wide base. Surrounding the mouth there is an epaulettelike structure situated dorsoventrally, bearing, according to Skrjabin, 10 papillae, of which 2 are the so-called lateral papillae or amphids, and 8 are the submedian papillae. The epaulettes are joined dorsally and ventrally by a cuticular band. The cylindrical esophagus is 17 mm. in length.

Male, 135 mm. to 140 mm. long and 680μ maximum breadth. Tail surrounded by a pair of alae supported by six pairs of preanal papillae (the last two pair may be adanal) and two pairs of postanal papillae. Skrjabin does not state whether the latter also support the alae. Spicules unequal; the left is 4.4 mm. long, bearing lancelike expansion at the tip, and the right is 660μ long and is bow-shaped. From the figure one would judge that the left spicule is comparatively strong and not delicate as in *H. setiferum* and *H. gouldi*.

Female, unknown.

Host.—*Varanus griseus*.

Location.—Under the peritoneal lining.

Distribution.—Russian Turkestan.

HASTOSPICULUM GOULDI Yorke and Maplestone, 1926

PLATE 3, FIGURES 8-11

Description.—*Hastospiculum*: Mouth opening, arrangement of papillae, and other head structures as in *H. varani*.

Male, about 180 mm. long. Anterior portion of the esophagus 300μ long, posterior portion 9.4 mm. long. Spicules unequal, the longer (left) being 1.1 mm. long and the shorter (right) 200μ long. Left spicule slender, delicate, and filiform or setaceous. A pair of caudal alae meet posteriorly and surround the tail. There are three pairs of large pedunculated preanal papillae, two pairs of smaller preanal papillae situated more subventrally, and one pair of large pedunculated postanal papillae. On the midventral line there are two conical processes, the first near the cloaca, the second near the tip of the tail. From the figure, as given by Yorke and Maplestone, there appear to be other papillae on each side of the posterior conical process.

Female, about 180 mm. long. Anterior portion of esophagus about 300μ long; posterior portion of esophagus, 16 mm. long,

glandular. Vulva approximately 1 mm. from the anterior extremity. Anus atrophied.

Host.—*Varanus gouldi*.

Location.—Presumably under the peritoneum.

Distribution.—Not given; probably Australasia.

Remarks.—Baylis (1930) states that *H. gouldi* may be a synonym of *H. macrophallos* Parona, but this seems unlikely since the left spicule of the latter species is very strong as compared with that of *H. gouldi*. *H. gouldi* is probably more closely related to *H. setiferum* and *H. onchocercum*, but it differs from these two species in the arrangement and number of caudal papillae of the male, length of spicules, length of body, and position of vulva in the female.

HASTOSPICULUM BIPINNATUM (von Linstow, 1899) Chandler, 1929

PLATE 3, FIGURES 4, 5

Synonym.—*Filaria bipinnata* von Linstow, 1899.

Description.—*Hastospiculum*: The head bears two small projections, which may be interpreted as being identical with the lateral liplike organs of *H. varani*. In both sexes the ends of the body are bluntly rounded, the posterior end tapering a little more than the anterior end.

Male, 32 mm. long by 590μ wide. Esophagus $\frac{1}{27}$ and tail $\frac{1}{32}$ of the body length; spicules unequal, the larger being 1.01 mm. long, and the smaller 190μ long. Six pairs of caudal papillae, four of them preanal and two postanal.

Female, 145 mm. long. Vulva $\frac{1}{12}$ of the body length from the anterior end. The embryonated eggs are 65μ long by 47μ wide.

Host.—*Varanus griseus*.

Location.—Lying loose under the peritoneum of the gut.

Distribution.—North Africa.

Remarks.—The data for this description were obtained from von Linstow's (1899) description and figures. He failed to state which of the spicules is the longer, and his figures do not show this; presumably the left is the longer. Skrjabin (1923) pointed out that *H. bipinnatum* differed from *H. varani* in length of body, length of esophagus, size of spicules, and number of preanal papillae.

HASTOSPICULUM SPINIGERUM Chandler, 1929

PLATE 1, FIGURES 5, 6

Description.—*Hastospiculum*: An anterior view of the head shows that the subrectangular mouth is surrounded by a cuticular elevation, which is not distinctly epaulettelike in contour, and that paired lateral projections arise from the outer margin of this circumoral eleva-

tion. There are three smaller papillate structures at the inner side of the base of each of these projections; they may, however, be under the surface. Eight submedian papillae, in addition to the paired lateral organs or amphids, are present.

Male (incomplete specimen), 75 mm. long by 560μ wide. The tail is provided with a pair of caudal alae. The larger left spicule is 2.75 mm. long and 42μ wide. The right spicule is only 420μ long. The single specimen is in poor condition, and the caudal papillae are somewhat difficult to see. There are five papillae supporting the right side of the caudal alae. The most posterior of these might be considered adanal. On the left side there are seven pedunculate papillae of which the most posterior two might be considered adanal. Toward the end of the tail there is a group of at least three sessile cone-shaped papillae, two on the right and one on the left side of the cone-shaped tail; the tail does not bear denticles.

Female, 220 mm. long by approximately 2 mm. wide. Anterior part of the esophagus 550μ to 570μ long and about 220μ wide; posterior part 520μ wide, length not determined. Vulva 850μ from the anterior end of the body. Opisthodelphous; the embryonated eggs present in the uterus measure 50μ to 52μ by 33μ to 34μ and are provided with an operculumlike structure at both ends. Tail bluntly rounded; anus somewhat atrophied, situated at the end of the tail.

Host.—*Varanus flavescens*.

Location.—Under the peritoneum.

Distribution.—Calcutta Zoological Gardens, Calcutta, India.

Type specimens.—U.S.N.M. Helm. Coll. No. 8009; paratypes, No. 8010.

Remarks.—This description was made from a restudy of the type specimens. The most outstanding differences between *H. spinigerum* and *H. gouldi*, *H. setiferum*, and *H. onchocercum* are in the relative coarseness of the left spicule. *H. spinigerum* might well be identical with *H. macrophallos*, as shown by Baylis, but there are important differences in the relative lengths of the spicules and in the number and position of the papillae on the tail of the male.

HASTOSPICULUM MACROPHALLOS (Parona, 1889) Baylis, 1930

PLATE 3, FIGURES 1-3

Synonym.—*Filaria macrophallos* Parona, 1889.

Description.—*Hastospiculum*: Mouth elongate dorsoventrally, surrounded by a circumoral elevation bearing a pair of laterally placed truncate teeth or liplike organs. There appear to be three finger-like processes converging toward the base of each of the toothlike structures. Baylis states that these may possibly be the attachments

of muscles, and is of the opinion that at least in *H. macrophallos* the so-called epaulettelike structure is not superficial but rather is a manifestation of subcuticular bodies. Only four submedian papillae are described. Concerning the presence of four additional submedian papillae Baylis states: "There is a faint indication of a structure of some kind, suggesting a papilla, near each corner of the 'epaulettes,' but this does not appear to be superficial, and it seems possible that it may be the point of attachment of a muscle or some other subcuticular structure." Lateral organs, or amphids, are situated in a position similar to that occupied by the same structures in other members of the genus.

Male, 80 mm. long, according to Parona (1889); maximum diameter 0.041 (probably meant to be 0.41 mm.). Spicules unequal, the left being 2 mm. long and 0.042 mm. wide, and the right 0.051 mm. long, according to Parona, or 0.04 mm., according to Baylis. Baylis suggests that the decimal point is misplaced in Parona's figure for the length of the right spicule. Parona figures four pairs of large pedunculated papillae, while Baylis figures only three, two preanal and one postanal. There are also three pairs of smaller, subventral, preanal papillae and two pairs of conical, postanal papillae. The figure of the tail of the male given by Parona shows the left spicule quite heavy, as would be expected from his measurement; Baylis's figure is not quite so clear in this respect.

Female, 250 mm. long by 1.4 mm. wide, according to Baylis and Daubney (1922), who found females that they described as *Filaria macrophallos*. The esophagus consists of a short, narrow, muscular portion 600 μ long, and a long, glandular portion 30 mm. long; the nerve ring surrounds the esophagus caudad of the middle of the anterior portion. Vulva 1.15 mm. from the anterior end. Tail bluntly rounded, bearing a pair of papillae at its extremity; anus terminal. Eggs embryonated, barrel-shaped, 50 μ long by 30 μ wide, with thick shells possessing annular thickenings. Parona (1889) had males only and hence gave no description of the female in proposing this species.

Hosts.—*Varanus (Hydrosaurus) salvator*, *V. nebulosus*, and *V. niloticus*.

Location.—Among the abdominal muscles.

Distribution.—Burma, India.

DISCUSSION

On the basis of characters of the ova, one would regard *Hastospiculum spinigerum* as at least very closely related to *H. macrophallos*. The relative thickness of the left spicule also presents a simi-

larity. However, the number of submedian head papillae for *H. macrophallos*, as given by Baylis, is four, while the number in the other members of the genus in which it is known is eight. *H. varani* and *H. bipinnatum* are too poorly described for conclusions to be drawn as to their possible identity with either of the above forms. Having only the present inadequate information as to the variation of the body length, the length of the spicules, and the number of tail papillae, one can not consider that any two of these species are identical. The above four species have one point in common, the relatively thick left spicule. On the other hand, *H. gouldi*, *H. setiferum*, and *H. onchocercum* have in common a narrow, delicate left spicule.

After a study of the literature and the three available species, it appears necessary to emend slightly the generic diagnosis as given by Yorke and Maplestone (1926), as follows:

HASTOSPICULUM Skrjabin, 1923

Generic diagnosis.—Filariidae: Mouth elongate dorsoventrally, more or less rectangular in outline, surrounded by a heavy cuticular elevation, which may or may not give the appearance of epaulettes, depending on the distinctness of the cuticular and subcuticular tissues; paired, lateral liplike organs projecting from the outer margin of the circumoral elevation, and smaller papillate structures sometimes present at the base of the latter; paired, lateral organs (amphids) and at least four, usually eight, submedian papillae; esophagus composed of a shorter, anterior, muscular portion and a longer, relatively wide, glandular, posterior portion. Vulva anterior, in the esophageal region; opisthodelphous; oviparous. Anus in the female more or less atrophied. Male with a single testis, spicules unequal, the left much longer than the right; tail surrounded by a pair of caudal alae supported by pedunculated papillae.

Type species.—*Hastospiculum varani* Skrjabin, 1923.

KEY TO THE SPECIES OF THE GENUS HASTOSPICULUM

For the purpose of separating the species described in this paper from those previously described, the following key is given:

1. Left spicule as wide as right..... 2
 Left spicule not so wide as right..... 5
2. Male 135 mm. to 140 mm. long; left spicule 4.4 mm. long, right
 spicule 660 μ long; female unknown..... *varani*
 Male less than 100 mm. long; left spicule not more than 2.75
 mm. long, right spicule not more than 510 μ long; female known..... 3

3. Male 32 mm. long; left spicule 1.01 mm. long, right spicule 190 μ long; female 145 mm. long; vulva 2 mm. from anterior end— *bipinnatum*
Male 75 to 80 mm. long; female more than 200 mm. long— 4
4. Left spicule 2.75 mm. long; six pairs of preanal papillae; vulva 850 μ from anterior end— *spinigerum*
Left spicule 2 mm. long; five pairs of preanal papillae; vulva 1.15 mm. from anterior end— *macrophallos*
5. Male 75 mm. long; left spicule 2.35 mm. long, right spicule 280 μ long; four pairs of preanal papillae; females 520 mm. to 540 mm. long, vulva 800 μ from anterior end— *setiferum*
Males not more than 56 mm. long; females not more than 350 mm. long— 6
6. Left spicule 1.1 mm. long, right spicule 200 μ long; five pairs of preanal papillae— *gouldi*
Left spicule 1.84 mm. to 2.20 mm. long; right spicule 240 μ to 280 μ long; four pairs of preanal papillae— *onchocercum*

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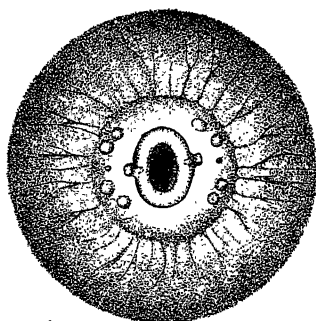
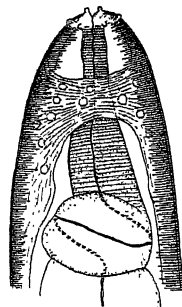
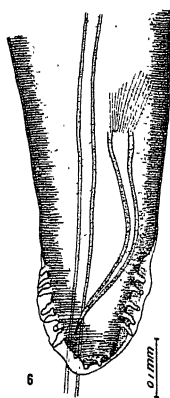
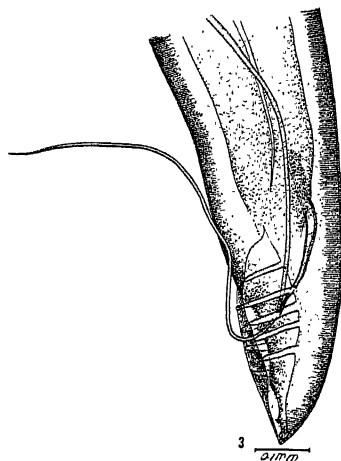
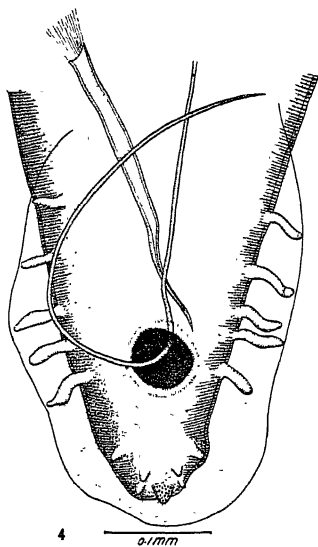
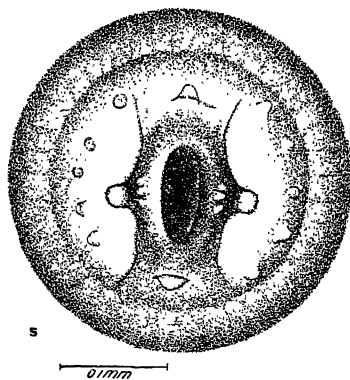
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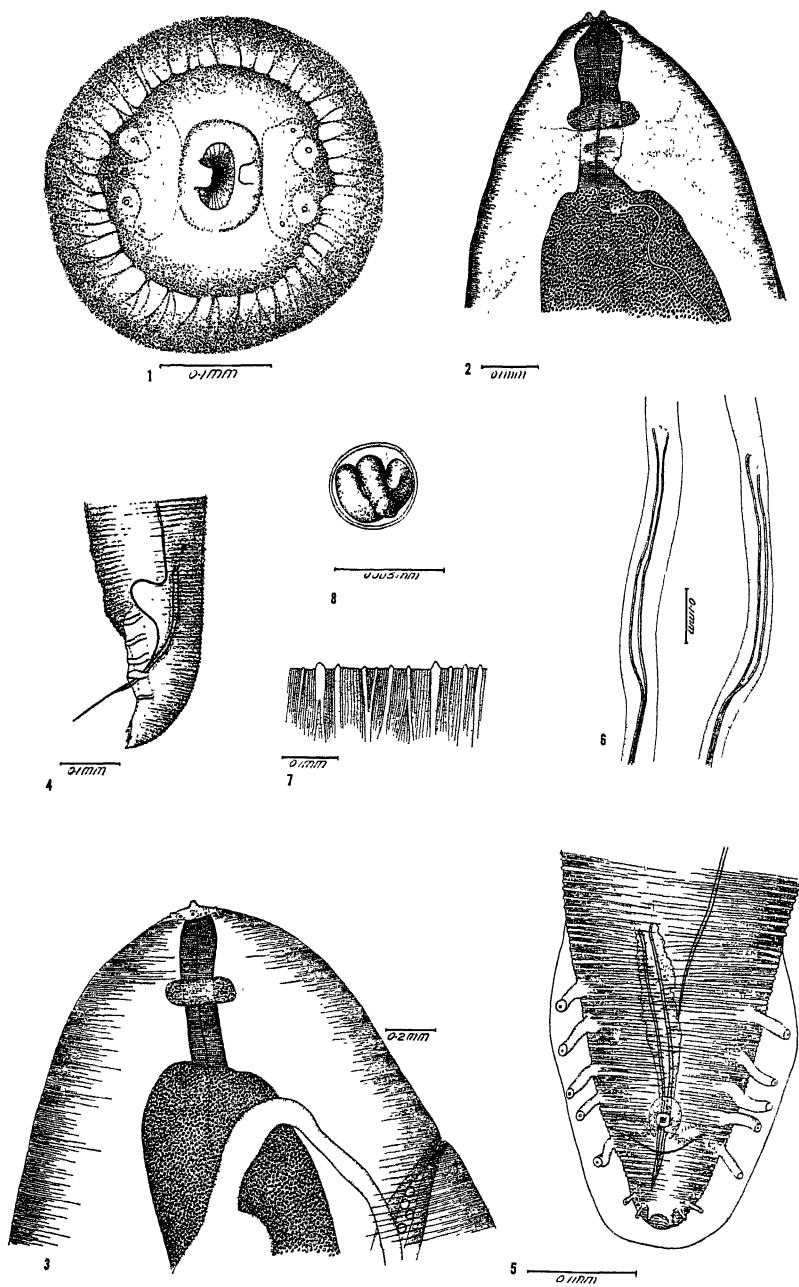
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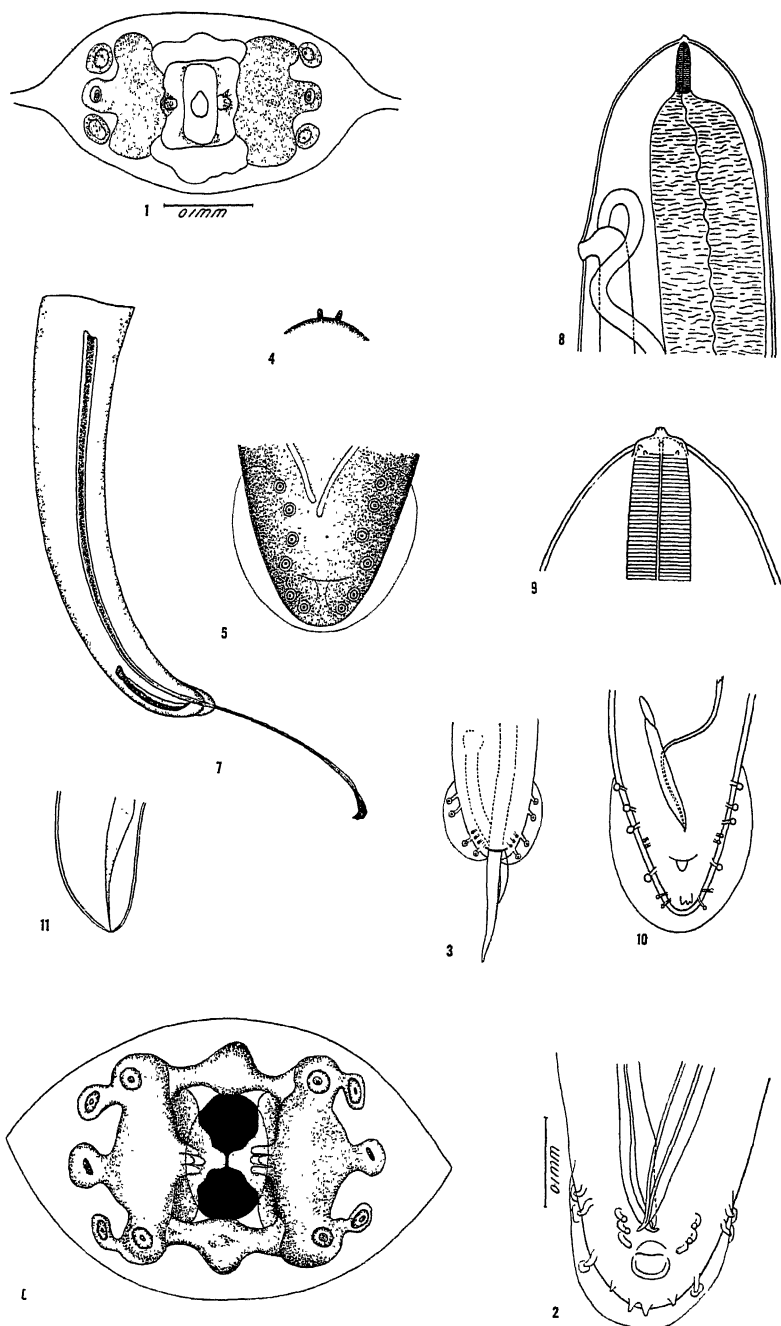
HASTOSPICULUM SETIFERUM, NEW SPECIES, AND H. SPINIGERUM

1-4, *Hastospiculum setiferum*: 1, Anterior view of head; 2, lateral view of anterior end of male; 3, lateral view of tail of male; 4, ventral view of tail of male.
5, 6, *H. spinigerum*: 5, Anterior view of head; 6, dorsal view of tail of male.



HASTOSPICULUM ONCHOCERCUM, NEW SPECIES

- 1, Anterior view of head; 2, lateral view of head of male; 3, lateral view of head of female; 4, lateral view of tail of male; 5, ventral view of tail of male; 6, anterior portion of left spicule, two views; 7, detail of cuticle; 8, egg.



SPECIES OF HASTOSPICULUM

- 1-3, *Hastospiculum macrophthallos*: 1, Anterior view of head (after Baylis, 1930); 2, ventral view of tail of male (after Baylis, 1930); 3, ventral view of tail of male (after Parona, 1880).
 4, 5, *H. bipinnatum*: 4, Lateral view of head; 5, ventral view of tail of male. (After von Linstow, 1899.)
 6, 7, *H. parani*: 6, Anterior view of head; 7, lateral view of tail of male. (After Skrjabin, 1923.)
 8-11, *H. gouldi*: 8, Lateral view of anterior end of female; 9, lateral view of head; 10, ventral view of tail of male; 11, tail of female. (After Yorke and Maplestone, 1926.)

RECORDS OF DIPTEROUS INSECTS OF THE FAMILY
TACHINIDAE REARED BY THE LATE GEORGE DIM-
MOCK, WITH DESCRIPTION OF ONE NEW SPECIES
AND NOTES ON THE GENUS ANETIA ROBINEAU-
DESVOIDY

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Several years ago Dr. George Dimmock gave to the United States National Museum a series of reared insects with his notes upon them. Many rearings of Tachinidae were included, the records for which were mostly unpublished. I planned to prepare the list for publication, but was obliged to await the appearance of Mr. Webber's revision of the genus *Achaetoneura*, as he was describing several of the species as new. The present paper lists the species as the lots were numbered by Doctor Dimmock, with a few necessary notes and the description of one new species. Several of the species are represented only by puparia, which have been identified for me by my colleague C. T. Greene, who has made an extensive study of the characters of early stages of Diptera.

A. REARED FROM LEPIDOPTERA

148. From *Sphinx chersis* Hübner. Cambridge, Mass., 1882. Puparia found in soil where caterpillar tried to pupate. Three females, identified by Webber as *Achaetoneura frenchii* Williston, "var.?"

246. From *Amphidasis cognataria* Guenee. Wachusett, Mass., 1882. Pupa only. Determined by Greene as *Exorista larvarum* Linnaeus (*Tachina mella* Walker).

423. From *Drepana bilineata* Packard. Cambridge, Mass., June, 1883. Pupa only. Greene finds that the puparium is different from any in the National Museum, and hence can not identify it.

505. From *Danaus archippus* Fabricius (*Anosia plexippus* Linnaeus of literature). Cambridge, Mass., emerged August 3, 1883. One male, four females. *Achaetoneura archippivora* Williston.

570. From *Sphinx chersis* Hübner. Cambridge, Mass., emerged June 13, 1884. Nine males and two females of *Sturmia incompta* Van der Wulp. The species was described as a *Brachycoma*,¹ and *inquinata* Van der Wulp is a synonym of it, as I found from the

¹ Biologia, Diptera, vol. 2, p. 99, 1890.

types in the British Museum. Coquillett had identified the Dimmock material as *Sturmia inquinata* Van der Wulp.

616. From larva on apple. Arlington, Mass., emerged June 17, 1884. One male of *Zenillia confinis* Fallen.

674. From *Diacrisia virginica* Fabricius. Springfield, Mass., 1885. Notes on moth with this number, but no reference to the parasite. Pupa only. Greene identified it as *Ernestia ampelus* Walker.

898. From arctian at Canobie Lake, N. H., 1889. Determined by Coquillett as *Exorista eudryae* Townsend. No specimens are to be found in the National Museum. There is no reason to doubt that Coquillett determined the species correctly; he had the same species from Dimmock several times, and the other material agrees with the revision of Aldrich and Webber, where the species is referred to the genus *Zenillia*.

934. From *Cingilia catenaria* Walker. Several rearings at Canobie Lake, N. H., in August, 1892. The Museum has under this number one male of *Phorocera claripennis* Macquart; one male of *Zenillia blanda* Osten Sacken, as restricted by Sellers; one *Sarcophaga rapax* Walker (*helicis* Townsend); and a long series of *Ceromasia aurifrons* Townsend. The last was determined by Coquillett as *Masicera festinans* Meigen.

963. From *Tephroclystis absynthiata* Clerck. Canobie Lake, N. H. One male of *Siphophyto floridensis* Townsend.

992. From mixed species of microlepidoptera on *Myrica asplenifolia* Linnaeus. Springfield, Mass., 1892. One female of *Zenillia blanda* Osten Sacken, as restricted by Sellers.

997. Adult flies near caterpillars of *Pheosia rimosa* Packard, as if waiting to oviposit. One female, same as No. 1009.

1009. From *Sphinx gordius* Cramer (?) at Canobie Lake, N. H. Emerged September 20, 1892. Thirteen specimens, both sexes, of *Winthemia quadripustulata* Fabricius, apparently a slight variant of the restricted form as made out by H. J. Reinhard in his recent studies.² The only difference that I note is the restriction of the parafacial hairs, which are almost confined to the upper half and inner or mesial portion of the parafacials.

1019. From *Sphinx chersis* Hübner. Canobie Lake, N. H., emerged June 23, 1893. Twelve males and females of *Sturmia incompta* Van der Wulp. See note to No. 570.

1031. From *Paonias excoecata* Smith and Abbott. Canobie Lake, N. H., emerged 1892. One small female of *Blepharipeza leucophrys* Wiedemann.

1112. From tortricid larva on *Baptisia tinctoria* Linnaeus. Arlington, Mass., emerged June 22, 1898. One male of *Actia pilipennis* Fallen. Determined as the same by Coquillett in 1905.

²Proc. U. S. Nat. Mus., vol. 79, art. 20, p. 14, 1931.

1126. From *Smerinthus geminatus* Say. Springfield, Mass., 1895. One female of *Achaetoneura frenchii* Williston, "var.?" Determined by Webber.

1181. From *Vanessa atalanta* Linnaeus. Springfield, Mass., emerged July, 1897. One male and three females of *Zenillia (Eusisyropa) futilis* Osten Sacken.

1227. From *Lagoa crispata* Packard. Chicopee, Mass., emerged May 10, 1898. One female of *Phorocera claripennis* Macquart. Same determination for Dimmock by Coquillett.

1232. From *Euthisanotia grata* Fabricius. Longmeadow, Mass., emerged June 5, 8, and 18, 1898, the caterpillars having been collected in the preceding year. One female in the National Museum, *Zenillia eudryae* Townsend.

1346. From lepidopterous larva on *Rhus copallina* Linnaeus at Springfield, Mass. Emerged June 5, 1898. Two males and one female of *Achaetoneura dimmocki* Webber. Type series.

1371. From *Euthisanotia* at Belchertown, Mass. Emerged June 19, 1898. One male and two females of *Zenillia eudryae* Townsend.

1372. From arctiid pupa (woolly bear?). Springfield, Mass., emerged June 8, 1898. One male of *Sturmia ricinorum* Townsend (*albifrons* Walker 1849, preoccupied). Determined by Coquillett as *albifrons*, correctly, but he was unaware of the preoccupation. I examined the type of Walker's species in the British Museum.

1441. From *Diacrisia virginica* Fabricius. Springfield, Mass., emerged August 18, 1898. I can not find any specimens with this number in the National Museum, but Dimmock's notes state that Coquillett determined the species as *Tachina mella* Walker. It is therefore reasonably certain that the species is what I now call *Exorista larvarum* Linnaeus, the same as No. 246.

1446. From *Cerura* at Springfield, Mass. Emerged September 3, 1898. One male and five females of *Exorista larvarum* Linnaeus.

1516. From *Automeris io* Fabricius. Tatham, Mass., emerged July 12, 1900. One male and three females of *Achaetoneura dimmocki* Webber. Type lot.

2103. From *Pholus* larva. Springfield, Mass., September, 1902. Sixteen specimens, both sexes, the type lot of *Achaetoneura pholi* Webber.

2646. From *Atreus plebeja* Fabricius (*Sphinx plebejus*). Springfield, Mass., 1920. One female of *Compsilura concinnata* Meigen.

B. REARED FROM COLEOPTERA

591. From larvae of *Ceruchus piceus* Weber. Milton, Mass., emerged in 1884 from larvae kept over winter. One male and one female, determined by Coquillett as *Theresia canescens* Walker. The

type of *canescens* in the British Museum is a *Ptilodexia*, quite distinct from the present species, which is the species named *Eutheresia monohammi*, new genus and species, by Townsend.³ I have examined with care the descriptions of three new species of *Eutheresia* by West and two by Curran, but on comparing the series of 28 specimens in the National Museum it seems that the pollen varies so much that I do not feel much confidence in the specific value of the characters offered for these species. I therefore tentatively allow our material to stand as *monohammi*.

1671. From *Chelymormpha cassidea* Fabricius (*argus* of authors). Springfield, Mass., emerged July 12, 1900. Two males and two females. The species was identified by Coquillett as *Hypostena barbata* Coquillett, which was a mistake. I am describing it as *Anetia dimmocki* in the present paper.

1820. From the pupae of *Monochamus scutellatus* Say. Springfield, Mass., emerged May 14, 1901. Two males, the same species as No. 591, *Eutheresia monohammi* Townsend.

1937. From *Ceruchus piceus* Weber. Springfield, Mass., emerged June 13, 1901. One female in poor condition, but no doubt the same as No. 591, *Eutheresia monohammi* Townsend.

2032. From *Xyloryctes* sp. at Wilbraham, Mass. Emerged May, 1902. One male and four females, correctly identified by Coquillett as *Macromeigenia chrysoprocta* Wiedemann.

2053. From *Ceruchus piceus* Weber. Springfield, Mass., emerged April 19, 1902. One female. Same as No. 591, *Eutheresia monohammi* Townsend.

2075. From *Chelymormpha cassidea* Fabricius (*argus* of authors). Chicopee, Mass. One male and three females, erroneously determined by Coquillett as *Masicera exilis* Coquillett. It is really the same species as No. 1671.

C. REARED FROM HYMENOPTERA

1115. Reared from sawfly larvae on *Pinus rigida* at Canobie Lake, N. H. Emerged about July 7, 1894. One small female of *Phorocera claripennis* Macquart, as identified by Coquillett.

1478. Found in wasp's nest, probably *Odynerus*, containing dipterous pupae, at Hollys Ledge, Holyoke, Mass., in October, 1898. Flies emerged June, 1899. One male and two females of *Pachyophthalmus signatus* Meigen. Correctly identified by Coquillett.

D. REARED FROM DEAD BAT

1356. Larvae in dead bat in barn, Springfield, Mass., eating all the flesh, 1898. Eighteen specimens of the fly, both sexes. *Sarcophaga securifera* Villeneuve. Identified by Coquillett as *Sarcophaga* sp.

³ Journ. New York Ent. Soc., vol. 20, p. 117, 1912; Insecutor Inscitiae Menstruus, vol. 4, p. 51, 1916.

ANETIA DIMMOCKI, new species

Description.—Smallish, rather slender, gray species, with three posterior dorsocentrals, black palpi, discals well developed, one bristle on outer side of middle tibia. Female with piercer and 2 to 4 pairs of striking blunt spines on edge of inflexed tergites 2 and 3, on middle of venter. Infrascapular setules absent.

Male: Front 0.225 of head width at vertex, not widening to middle; pollen of parafacials, parafrontals, and face grayish white, hardly silvery. One pair verticals, ocellars large and proclinate, three pairs reclinate frontals above, the uppermost, however, very small; about nine other frontals, the single row ending at about middle of second antennal joint. Parafrontal with only a few very minute hairs besides frontals; frontal stripe dark brown, wider above than one parafrontal; parafacial bare, narrower at its middle than third antennal joint. Antennae black, third joint rather slender, almost reaching vibrissae, hardly more than twice as long as the second joint. Arista thickened on basal third, microscopically pubescent, basal joints short. Vibrissae at oral margin, only a few hairs above them on the divergent part of the ridges. Cheek one-seventh eye height. Eyes bare; back of head with white hair except one row behind eye.

Thorax black, subshining, from behind showing thin pollen, on which a pair of slender black stripes lie between the acrostichals and the dorsocentrals and extend considerably behind the suture; outside the dorsocentrals a pair of broader black stripes reaching to the hindmost dorsocentral. Acrostichal, 3, 3, one pair close in front of the suture; inner presutural (anterior intraalar) present; sternopleural, 2, 1. Scutellum black to apex with three pairs marginal, one smallish discal, and a pair of decussate apicals about half as long as adjacent marginal; the apicals are only a little upturned.

Abdomen black, pointed, rather slender, second to fourth segments of equal length, first not much shorter; one-half or more of second and third segments shining black, the base with an ill-defined band of gray pollen fading out behind and clearly interrupted in the middle; fourth segment with narrower basal band hardly interrupted. First segment with a pair of strong medium marginals, second with a discal and a marginal pair, the latter stouter; third with discal pair and stout but sparse marginal row numbering only six in the whole width; fourth segment with stout bristly erect hairs all over dorsal surface and a few irregular bristles, apex especially below with long backwardly directed bristles. Venter mostly shining except in very oblique view. Along the median dorsal region between the bristles of second and third segments the hairs are noticeably erect and coarse.

Legs black, tarsi long, claws and pulvilli long, the latter brownish; front tibiae with one outer bristle below middle; hind ones irregularly bristled on outer side.

Wings hyaline, third vein with 2 to 4 setules at base above and below; fourth vein with rounded, oblique bend, then straight to margin, joining the costa not very far before extreme apex of wing, the distance being equal to half the length of the hind cross vein. Calypters white.

Length, 5.5 mm.

Female: Front at vertex 0.25 of head width, widening very little until close to antennae; pollen of front distinctly yellowish; parafrontals wider than in male but parafacials not. Outer verticals not half as long as inner; ocellars smaller than in male; third antennal joint slightly shorter, not quite twice the second. Dorsal bristles of abdomen as in male but less strong, no erect hairs along median line. The stubby bristles of venter, mentioned in diagnosis, may be very striking if the venter happened to dry with protruding keel, or may be difficult to see if the keel is completely flattened down. The length of the fourth segment below is considerably longer than that of the two preceding segments combined.

Length, 4.4 mm.

Type.—Male, U.S.N.M. No. 43589.

Remarks.—The foregoing description is based on the type and allotype. Most of the other females do not show the yellow tinge to the parafrontal pollen. A few of the numerous females lack the pair of discals on the second segment. Several males have a distinct brownish tinge on the wings and calypters.

Described from the following material (all paratypes except the first two):

- (a) Type, allotype, one additional male and two females, reared from *Chelymormpha cassidea* Fabricius, at Chicopee, Mass., by George Dimmock (Dimmock No. 2075).
- (b) One male and one female, reared from the same host in 1900, at Springfield, Mass., by Dimmock (Dimmock No. 1671).
- (c) Two males and two females, reared from the same host in New Hampshire by workers of the Gipsy Moth Laboratory (G. M. L. No. 12172).
- (d) One male, one female, reared from the same host in 1900, at Chicopee, Mass., by F. Knab.
- (e) One male, Hatch Experiment Station of Massachusetts, with label, "Parasite on Lady-bird." The host larva was probably the same as preceding, which might easily be mistaken for a coccinellid. The date is August 10, 1895.
- (f) One female, reared from the same host as type, at Cedar Keys, Fla., by Hubbard and Schwarz, May 6, 1875.

- (g) One male, one female, reared from same host, at Arlington, Va., July 2 and 9, 1919, by M. T. Van Horn (Chittenden No. 6062).
- (h) One male, reared at College Park, Md., from *Coptocycla* sp. by K. C. Babcock (Chittenden No. 6017).
- (i) One male, one female, reared from *Deloyola clavata* Fabricius, from North Carolina Department of Agriculture, presumably reared in that State.
- (j) Six males and eight females, reared at Baton Rouge, La., from *Mettriona bicolor* Fabricius, July and August, 1921, by C. E. Smith (Chittenden No. 7030).
- (k) Thirty-three collected specimens (22 males and 11 females): 3 males, Lawrence, Kans., 1893, identified for the writer by D. W. Coquillett about 1898 as *Hypostena barbata* Coquillett; 12 males and 4 females, La Fayette, Ind.; one male, Turtle Mountains, N. Dak., June 21, 1918; one female, Mount Vernon, Va., July 21, 1923; one female, Great Falls, Va., August 9, 1923; one female, Shenandoah River, Clarke County, Va., September 3, 1923 (all the preceding collected by the writer); two males, Sandusky, Ohio, July (Reinhard); two males, Blendon, Ohio, September 11, 1901 (Hine); one male, Sugar Grove, Ohio, June 20, 1926, no collector; one female, College Station, Tex., June 1, 1923 (Reinhard); one male, Bexar County, Tex., June 9, 1928 (Parks); one female, Meridian, Miss., September 3, 1922 (Allen); one female, Onondaga County, N. Y., August 11, 1897, no collector; and one female, Falls Church, Va., September 6 (Banks).

Coquillett⁴ records a specimen of *Hypostena barbata* Coquillett as bred from a larva of *Coptocycla clavata* Fabricius, at College Park, Md., by Willis G. Johnson. I am unable to find the specimen in the National Museum at present; but as Coquillett was considerably confused in his identifications of what he called this species, and identified my Lawrence, Kans., males of *dimmocki* as the same, it is very probable that this rearing record also belongs to *dimmocki*.⁵

NOTES ON THE GENUS ANETIA

The genus *Anetia* was described by Robineau-Desvoidy,⁶ with the single species *occlusa*, new, which Bezzi⁷ made a synonym of *Tachina nigripes* Zetterstedt. The latter has been supposed for years to be the type species of the genus *Lydella* Robineau-Desvoidy; but Doctor Villeneuve⁸ has shown that *Lydella* has been entirely misunder-

⁴ Revision of the Tachinidae of America North of Mexico, Tech. Ser. No. 7, Div. Ent., U. S. Dept. Agr., p. 17, 1897.

⁵ See Aldrich, Proc. Ent. Soc. Washington, vol. 30, p. 42, 1928.

⁶ Dipteres de environs de Paris, vol. 1, 1863, p. 863.

⁷ Catalogue of Palaearctic Diptera, vol. 3, p. 292, 1907.

⁸ Bull. et Ann. Soc. Ent. Belgique, vol. 49, p. 103, 1929; Konowia, vol. 9, p. 218, 1930.

stood, and its type species *grisescens* Robineau-Desvoidy is the species which has been known in recent literature as *Masicera senilis* Meigen (and which should be known as *Lydella grisescens* Robineau-Desvoidy, since the true *senilis* of Meigen is an entirely different species). There appears to be no earlier generic name for what has been called *Lydella* than *Anetia*, and Doctor Townsend in a recent letter advises me that he adopts this.

The striking genitalic characters of the females, with piercer and stubby ventral abdominal spines, imply such biological difference that they should if possible be recognized as generic, although I readily admit that it is difficult to separate the males of these species from those in which the females do not have a piercer. *A. dimmocki* differs from the type of *Anetia*, *Tachina nigripes* Zetterstedt, a European species represented in the National Museum by several specimens of both sexes indentified by Villeneuve, Bezzi, and Nielsen, chiefly in lacking the tuft of minute setules underneath the calypter (a single distinct setule is present in one male from La Fayette); *nigripes* also has several large bristles on the outer front side of the middle tibia, not usually regarded as generic. *A. dimmocki* fits better here than in *Dexodes* Brauer and Bergenstamm (in which I would include as synonyms *Parameigenia* Townsend, *Paradexodes* Townsend, and *Aubaeanetia* Townsend), as the latter has no piercer in the female.

INSECTS OF THE ORDER ORTHOPTERA OF THE PINCHOT EXPEDITION OF 1929¹

By A. N. CAUDELL

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The Orthoptera brought back in 1929 by the Pinchot Expedition to the South Seas were mostly taken on Barro Colorado Island, Canal Zone, and in the Galapagos Islands. This material, numbering 66 specimens of 20 species, represents no new genera and but one new species. There are, however, a number of new geographical records.

For convenience the following report is separated under geographical headings. All specimens bear the Pinchot expedition label, and one indicates the collector, Dr. A. K. Fisher. Some also bear the Accession No. 105848.

WEST INDIES

Nymphs of two well-known roaches comprise the only Orthoptera brought by the expedition from the West Indies. They are as follows:

Family BLATTIDAE

Periplaneta australasiae Fabricius: One small nymph labeled "G. Cayman, W. I., Apr. 17, 1929."

Pycnoscelus surinamensis Linnaeus: One immature specimen bearing same data as above.

BARRO COLORADO ISLAND. CANAL ZONE

The artificial island of Barro Colorado, standing in an artificial lake resulting from the Panama Canal project, seems to be a naturalist's paradise. Fairchild² presents a map of the island and its surroundings, together with several excellent photographs; and a small book by W. C. and M. H. Allee, entitled "Jungle Island," published in 1925, has to do with the flora and fauna of this island, but it contains no reference to Orthoptera. The only paper known to the writer listing even in part the forms occurring on Barro Colorado is one by Allee³ in 1926, which listed representative forms of various

¹ The narrative of this expedition will be found in the book *To the South Seas*, by Gifford Pinchot, published in 1930.

² *Journ. Heredity*, vol. 15, pp. 99-102, 1924.

³ *Ecology*, vol. 7, pp. 445-468, 1926.

stratifications of the tropical forest. No list of the Orthoptera of the island as a whole has yet appeared, and special collections should be formed before such a list approaching completeness is attempted.

All the Orthoptera taken here were collected on May 3, 1929.

Family TETTIGONIIDAE

Subfamily PHANEROPTERINAE

Insara bolivari Griffini: Two adult males. The National Museum also contains a male of this species taken on the island by S. W. Frost, January 21, 1929.

Subfamily LISTROSCELINAE

Phlugis teres De Geer: One adult female. A female taken by N. Banks on the island on June 26, 1924, is in the National Museum.

Family ACRIDIDAE

Subfamily ACRIDINAE

Amblytropidia insignis Hebard: One adult male.

Orphulella punctata De Geer: Three male and three female adults and one immature female. All these are of the brown phase, but specimens of both green and brown forms were taken on the island by P. Rau and are in the National Museum.

Subfamily OEDIPODINAE

Heliasius venezuelae Saussure: A single female is labeled "From boat 2 days out from Panama, July 23, 1929." Thus its exact locality of origin is unknown, but it is probably not Barro Colorado Island. Aside from *Paulinia acuminata* De Geer, which is included by Hebard under the subfamily name Pauliniinae, this seems to be the only member of the subfamily Oedipodinae now in our Panamanian lists.

Subfamily CYRTACANTHACRINAE⁴

Opshomala cylindroides Stal: One female. The female of this species and that of *O. goethalsi* Hebard are said to be almost inseparable.

⁴Recently this rather well-established subfamily name for the spine-breasted grasshoppers has been dropped by some writers in favor of the name Catantopinae. As priority does not prevail in names higher than genera, one is allowed to use his judgment in such matters. If any change at all were necessary the name Podisminae would be preferable, as that is based on the oldest included generic name. Indeed this name is so much shorter and more euphonic that it would be chosen by the present writer for adoption except for the fact that the longer name Cyrtacanthacrinae is now so well established in general use.

arable. Neither species seems to have been recorded before from Barro Colorado, and the present specimen is here listed as *cylindrodes* mostly because it is the older of the two names.

Osmilia flavolineata De Geer: One male.

Xyleus rosulentus Stal: One adult male taken on the island by Allee. This species was not collected by the Pinchot expedition, but it is entered here for the purpose of record and to introduce the following matter for nomenclatorial interest:

In 1822 Kuhl erected a genus of reptiles under the name *Tropinotus*, which was, as I am informed by Dr. Leonhard Stejneger, a nomen nudum. Four years later, Bois⁵ validated the genus under the emended name *Tropidonotus*. In 1831 Serville erected his genus *Tropinotus* in the Orthoptera, and this generic name was emended to *Tropidonotus* by Stal in 1878. In 1848 Gistel⁶ proposed the generic name *Xyleus* to replace the preoccupied Servillean name. Not knowing of this erection of a replacing name by Gistel, Bolivar introduced for the same purpose the new name *Diedronotus* in 1906. Thus it is clear that Gistel's name *Xyleus* is the proper name for this genus, *Tropinotus* and *Diedronotus* falling into synonymy under Gistel's name.

GALAPAGOS ISLANDS

The Orthoptera of the Galapagos have been rather fully covered. Günther in 1877⁷ presented a report on the forms taken in these islands by the expedition of H. M. S. *Peterel*; in 1889⁸ Howard listed a few forms; and Scudder,⁹ in 1893, gave an illustrated report of the Orthoptera of the Galapagos Islands in which appears a résumé of earlier literature, the most comprehensive treatment of the fauna of this region up to that time. In 1901 McNeill¹⁰ reported on the Orthoptera of the Hopkins Stanford Galapagos expedition of 1898-99, and in the following year Snodgrass¹¹ discussed the acridid genera *Schistocerca*, *Sphingonotus*, and *Halmenus* occurring in these islands. This paper is accompanied by a map of the islands comprising the Galapagos Group. The latest comprehensive report on Galapagos Orthoptera is by Hebard,¹² who treats the material collected by the expedition of the California Academy of Sciences to the Galapagos Islands, 1905-6. A review of previous records is also given. The latest mention of importance

⁵ Isis von Oken, 1826, p. 205.

⁶ Naturgeschichte des Thierreichs für höhere Schulen, p. xi, Stuttgart, 1848.

⁷ Proc. Zool. Soc. London, 1877, pp. 87-88.

⁸ Proc. U. S. Nat. Mus., vol. 12, pp. 192-194, 1889.

⁹ Bull. Mus. Comp. Zool., vol. 25, no. 1, 25 pp., 3 pls., 1893.

¹⁰ Proc. Washington Acad. Sci., vol. 3, pp. 487-506, 1901.

¹¹ Proc. Washington Acad. Sci., vol. 4, pp. 411-454, pls. 26, 27, 1902.

¹² Proc. California Acad. Sci., ser. 4, vol. 2, pp. 311-346, 1 pl., 11 figs., 1920.

is by William Beebe in 1924 in his book "Galapagos, World's End," where *Anaulacomera darwinii*, *Galapagia solitaria*, *Schistocerca melanocera*, and *Halmenus robustus* are noted. These references include two new island records, *Galapagia solitaria* from Seymour Island and *Halmenus robustus* from Tower Island. The following species were also taken by Beebe but were not mentioned in his printed book: *Conocephalus exitiosus*, an immature female, Conway Bay, Indefatigable Island, May 1, 1923; *Gryllus assimilis*, one half-grown male nymph on Tower Island, April 28, 1923; *Cryptoptitum lepismoide*, an adult male on Tower Island, April 28, 1923. This last constitutes a new island record.

The Orthoptera of the Galapagos brought back by the Pinchot expedition are as follows:

Family TETTIGONIIDAE

Subfamily PSEUDOPHYLLINAE

Liparoscelis cooksoni Butler: One female, Tower Island, June 16. This short-winged katydid has hitherto been recorded from 6 of the 16 main islands of the Galapagos group, but the present record is the only one from Tower Island.

Family ACRIDIDAE

Subfamily OEDIPODINAE

Sphingonotus fuscoirroratus Stal: Three males and one female, Hood Island, July 1. This small grasshopper is recorded from 11 of the 16 islands.

Subfamily CYRTACANTHACRINAE

Halmenus robustus Scudder: Two males and two females from Tower Island, June 16. First record from Tower Island. From a careful study of descriptions and comparison with a paratype, this seems to be typical *robustus*.

Schistocerca literosa var. *hyalina* Scudder: Six males, three females, taken on Tower Island on June 16.

Schistocerca literosa var. *punctata* Scudder: Two females, Hood Island, July 1.

The above determination of varieties is made mostly from the respective localities of capture. From comparisons made with the

characters given in tabular form by Scudder,¹³ which Hebard¹⁴ says will easily distinguish these forms, I fail to appreciate differentiating characters of real value.

Schistocerca melanocera Stal: One adult female and a female nymph from Charles Island, June 27; 1 male and 2 females from Tower Island, June 16; and 3 males and 3 females labeled only Galapagos, June 19.

The specimens from Tower Island constitute a new island record. They, as well as the female from Charles Island, agree exactly with the colored figures of Hebard's paper of 1920, but those bearing the label "Galapagos" are decidedly lighter yellowish. These specimens were, however, evidently discolored from having been collected in spirits.

This is evidently the large grasshopper noted by Mr. Pinchot in his book on the expedition as being eaten with avidity by a large lizard.

Schistocerca intermedia Snodgrass: One adult male and an immature female on Duncan Island, June 26. The adult agrees exactly with the colored figure given by Hebard, sexual differences being allowed for.

Family GRYLLIDAE

Subfamily GRYLLINAE

Gryllus assimilis Fabricius: One male and two females, Charles Island, June 28. All macropterous.

MARQUESAS ISLANDS, OCEANIA

Three species only of Orthoptera were brought back from the Marquesas, one being undescribed. They are as follows:

Family TETTIGONIIDAE

Subfamily LISTROSCELINAE

Phisis? sp.: One male without legs. Fatuhiva, September 18.

Subfamily COPIPHORINAE

Euconocephalus lineatipes Bolivar: One female, Fatuhiva, September 18.

¹³ Bull. Mus. Comp. Zool., vol. 25, p. 16, 1893.

¹⁴ Proc. California Acad. Sci., ser. 4, vol. 2, p. 327, 1920.

Family ACRIDIDAE

Subfamily CYRTACANTHACRINAE

PATANGA PINCHOTI, new species

Collected on Eiao, September 28, 1929.

This species runs out to the genus *Patanga* in the key given by Uvarov in his revision of the group Cyrtacanthacrini.¹⁵ Some relation to the genus *Austracris* is indicated in the somewhat strongly retrorse prosternal spine, and it is indeed possible that it really should be referred there. This species is named in honor of the noted leader of the expedition, Hon. Gifford Pinchot.

Description.—Head with the face rather strongly retreating; eyes almost but not quite twice as high as long, the anterior margin straight; fastigium of vertex flat, transverse diamond shaped, broadly rounding into the frontal costa, which is equally broad throughout, or barely narrowed at the ocellus, and with the slightly elevated lateral margins just reaching the clypeus; antenna about twice as long as the pronotum.

Pronotum with a very low but persistent median carina, the lateral carinae indicated only posteriorly; the pronotal disk cut by three transverse sulci, the posterior one situated about the middle; the anterior margin of disk almost straight, very slightly and roundly angulate, while the posterior margin is obtuse-angulate, the tip entire and narrowly rounded. The surface of the pronotal disk is punctated on the metazona, the rest dully rugose. Prosternal spine sub-cylindrical, apically pointed and the whole directed rather decidedly backward, though normally not nearly reaching the mesosternum; in a couple of somewhat crushed specimens almost or quite reaching the sternum. Tegmina rather slender, apically slightly narrowed and curved very gently backward, the apical third more transparent than the basal portion: wings hyaline with black venation.

Posterior femora rather slender and with the apical third or more with the margins subparallel.

Cerci of the male slender, gently flattened laterally, tapering gradually to a point, gently curved inward, the whole about five times as long as basally broad and reaching the tip of the supraanal plate. Supraanal plate sulcate above in the basal half or slightly more, the lateral margins straight and gently converging to near the triangularly pointed tip, where they terminate in a lateral shoulder. Sub-genital plate of male elongate, sharply pointed and directed upward and backward, extending decidedly beyond and slightly above the tip of the supraanal plate. Valves of the ovipositor moderately recurved.

¹⁵ Ann. Mag. Nat. Hist., ser. 9, vol. 11, p. 143, 1923.

General color brown, the tegmina obscurely maculate with rather large rounded spots of darker color; side of pronotum with a generally obscure dark spot, and the head with a distinct postocular stripe and sometimes with a dark perpendicular streak below the eyes; legs marked with black spots, especially noticeable on the posterior femora.

Measurements.—Length, to end of tegmina, ♂ 41, ♀ 51 mm.; antenna, ♂ 14, ♀ 16 mm.; pronotum, ♂ 7, ♀ 8.5 mm.; tegmina, ♂ 33, ♀ 46 mm.; posterior femora, ♂ 20, ♀ 25 mm.; cerci, ♂ 2.25 mm.

Type material.—Four males and seven females and one female nymph. Type, ♂; allotype, ♀; and paratypes A to C, ♂, D to I, ♀, and J, nymph. Type, U.S.N.M. No. 43590.

Remarks.—There is very little variation in size or appearance noticeable in this series of specimens.

The present species seems much like the one described as *Valanga rapana* by Uvarov¹⁶ and may indeed prove to be the same. Its characters appear, however, to indicate proper association with the species of the genus *Patanga* rather than those of the genus *Valanga*. If Uvarov's species does ultimately prove to be the one here described, it would seem advisable to refer it to the genus *Patanga*.

The *Valanga stercoraria* of Holdhaus may belong to *Patanga*, or to a new one. Certain of the characters noted for that species by Uvarov¹⁷ seem at variance with those of the genus *Valanga*. The excised posterior margin of the pronotal disk of *stercoraria* mentioned by Uvarov is not noted in the original description of the species by Holdhaus.¹⁸

¹⁶ Ann. Mag. Nat. Hist., ser. 9, vol. 19, p. 560, fig. 2, 1927.

¹⁷ Ann. Mag. Nat. Hist., ser. 9, vol. 12, p. 359, 1923.

¹⁸ Denkschr. kais. Akad. Wiss., math.-naturw. Klasse, Wien, vol. 84, p. 557, 1909.

NEW WEST INDIAN CERAMBYCID BEETLES

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The present paper is the result of a study of the beetles of the family Cerambycidae from the West Indies found in the collection of the United States National Museum, together with the material borrowed from the American Museum of Natural History, New York, and the Museum of Comparative Zoology, Cambridge, Mass. Specimens from the West Indies have been received at various times for identification, many of which were forms undescribed, and it seems advisable to describe these so that names will be available for listing the species from that region. Four genera and 63 species are herein described as new.

Subfamily PRIONINAE

XIXUTHRUS DOMINGOENSIS, new species

Xixuthrus sp. Russo, Bol. Lab. Zool. Gen. e Agr. Portici, vol. 24, p. 141, 1930.

Male.—Very large, robust, strongly convex, brownish black, with the elytra more reddish brown.

Head longer than wide, deeply depressed behind the epistoma and on vertex, with a narrow, longitudinal, median groove extending from frontal depression to occiput; surface finely, confluent punctate, rather densely clothed with short, recumbent, yellowish-white pubescence; antennal tubercles narrowly separated and strongly elevated; mandibles robust, long, and strongly, arcuately deflexed, inner margin of each mandible armed with a small tooth at base, a large, broad tooth near middle, and the apex prolonged into a large, rather acute tooth, surface coarsely, densely rugose; eyes large, oblong, strongly convex, vaguely emarginate, and separated from each other on the top by about the width of the upper lobe. Antenna extending to apical fourth of elytron; first joint robust, subcylindrical, coarsely punctate above, scabrous beneath, extending to anterior

margin of pronotum, nearly twice as long as the third joint, which is slightly longer than the fourth; apical joints longitudinally rugose, the eleventh joint distinctly longer than the tenth.

Pronotum nearly twice as wide as long, distinctly narrower at apex than at base, and widest at base; sides nearly parallel posteriorly, arcuately narrowed anteriorly, and strongly, regularly spinose; disk moderately convex and uneven; surface finely, confluent punctate, sparsely clothed with short, inconspicuous pubescence, and ornamented on each side of middle with an irregularly shaped, smooth area, which is acutely produced anteriorly, and with two very narrow, more or less distinct, smooth spots on each side toward lateral margin. Scutellum strongly transverse, broadly subtruncate at apex, surface densely punctate, sparsely clothed with short, recumbent, yellowish-white pubescence, and with a narrow, longitudinal, median, smooth vitta.

Elytra five times as long as pronotum, and at base subequal in width to the pronotum at base; sides parallel or vaguely expanded at middle, tips separately, broadly rounded, each with a small tooth at sutural margin; surface vaguely rugose, feebly, finely, densely punctate, with a few coarse punctures intermixed, densely clothed with very short, recumbent, whitish pubescence, which nearly conceals the surface, and each elytron with two vague, longitudinal costae, extending from base to apical fourth.

Abdomen beneath feebly, finely, sparsely punctate, sparsely clothed with short, recumbent, whitish hairs, posterior margin of each segment smooth, and glabrous at middle; last segment broadly, feebly, arcuately emarginate at middle. Prosternum finely, confluent punctate, and nearly glabrous; prosternal process rather narrow, arcuately expanded behind the coxal cavities, and rounded at apex. Legs long, scabrous, especially the anterior pair; femora more or less serrate on inner margins; anterior tibiae slightly arcuate, and armed with numerous asperities on undersides.

Length, 78–85 mm.; width, 28–30 mm.

Type locality.—Santiago, Dominican Republic.

Other locality.—San Pedro de Macoris, Dominican Republic.

Type.—U.S.N.M. No. 43705. Collected in 1926 by Giuseppe Russo.

Paratype.—In American Museum of Natural History. Collected on the Conseulo Plantation, San Pedro de Macoris, Dominican Republic, in 1919, by an officer in the American Army.

Remarks.—Described from two males (one the type).

This species resembles *Xixuthrus costatus* Montrouzier, described from Woodlark Island, but it differs from that species in having the antennal tubercles more narrowly separated, pronotum finely,

confluently punctured, and distinctly pubescent, each elytron with two longitudinal costae, and the pubescence distinctly shorter, basal joints of antennae scabrous, and the prosternum finely, confluent punctured.

This is the first species of the oriental tribe Xixuthri to be found in America. All the other described species of this tribe are indigenous to the East Indies. It is the second species of oriental Cerambycidae to be recorded from the West Indies, the other species being *Bato-cera rubus* Linnaeus.

MONODESMUS ATRATUS, new species

Male.—Broadly elongate, strongly flattened above, rather strongly shining, and uniformly black above and beneath.

Head strongly transverse, somewhat uneven, and deeply, transversely concave in front, strongly, deeply concave between the antennal tubercles, which are widely separated and rather strongly elevated, the surface nearly glabrous, coarsely, deeply, confluent punctate, and more or less rugose; eyes large, strongly convex, moderately emarginate, and separated from each other on the top by nearly twice the width of the upper lobe. Antenna one and one-fourth times as long as the body, finely, densely punctate, vaguely pubescent, the joints flattened, and strongly, longitudinally carinate; first joint short, cylindrical, feebly expanded toward apex, one-half as long as the third joint, which is distinctly longer than the fourth; eleventh joint distinctly longer than the tenth.

Pronotum one and one-half times as wide as long, subequal in width at base and apex, and widest at middle; sides parallel, sinuate, and armed on each side at middle with a very long, acute tooth; disk uneven, with two large, round, coarsely punctured gibbosities, arranged longitudinally on each side of the middle, and a smooth, elongate gibbosity in front of the scutellum; surface coarsely, irregularly, confluent punctate, and sparsely clothed with long, inconspicuous hairs. Scutellum elongate-triangular, rounded at apex, and coarsely punctate.

Elytra five times as long as pronotum, and at base distinctly wider than pronotum at middle; sides nearly parallel, feebly, broadly constricted behind middle, the tips conjointly, broadly rounded, with a small, distinct tooth at the sutural angles; disk moderately convex; surface coarsely, deeply, confluent punctate from base to apex, clothed with a few semierect, inconspicuous hairs, and each elytron with two vague, longitudinal costae, extending from base to apical fifth.

Abdomen beneath finely, densely granulose, finely, sparsely punctate, and rather densely clothed with long, semierect, whitish hairs;

last segment broadly, arcuately emarginate at apex. Prosternum narrowly transverse, coarsely punctate, rather densely clothed with long, erect, inconspicuous hairs; prosternal process narrow, strongly, arcuately elevated between the coxal cavities, and broadly rounded at apex. Legs long, coarsely, densely punctate, somewhat rugose, sparsely clothed with moderately long, whitish hairs; femora subcylindrical, slightly flattened; tibiae flattened, feebly, gradually expanded toward the tips.

Length, 16 mm.; width, 4.5 mm.

Type locality.—Sierra Rangel, Cuba.

Type.—U.S.N.M. No. 43706. Collected by Brother Roberto, of the La Salle School, Habana, in the Province of Pinar del Rio, Cuba, in 1930, and labeled "Estacion Experimental Agronomica, Cuba, No. 9437."

Remarks.—Described from the type, a unique male.

This species is allied to *callidioides* Serville, but it differs from that species in being uniformly black, and with the elytra coarsely, confluent punctured.

Subfamily CERAMBYCINAE

PSEUDOEME, new genus

Head broad, feebly concave between the antennal tubercles, the front vertical, and wider than long. Mandibles short, robust, arcuate, entire, and rather acute at apices. Ligula corneous. Palpi 3-jointed, the maxillary twice as long as the labial, and the apical joints elongate-triangular. Antenna slender and shorter than body in the female, more robust basally and longer than the body in the male, densely ciliate beneath; first joint robust, subcylindrical, without a cicatrix at apex, and shorter than the third joint. Eyes large, coarsely granulated, and deeply emarginate. Pronotum about as long as wide, feebly constricted at base, even on disk, rounded but not tuberculate at the sides. Scutellum transversely oval. Elytra elongate, parallel, slightly flattened, and rounded at apex. Abdominal segments subequal in length. Mesosternum flat, and very narrow between the intermediate coxal cavities, which are open externally. Prosternal process very narrow, and not prolonged behind the anterior coxal cavities, which are nearly contiguous, and strongly angulated externally. Legs moderately long, subequal in length; femora robust, flattened, and strongly, abruptly clavate; posterior tarsus with the first joint as long as the following joints united.

Genotype.—*Pseudoeme poolei*, new species.

This genus belongs to the tribe Oemini and is allied to *Oeme* Newman, but it differs from that genus in having the maxillary palpi

twice as long as the labial palpi, with the apical joints elongate-triangular, and the prosternal process not extending behind the anterior coxal cavities.

PSEUDOEME POOLEI, new species

Male.—Elongate, parallel, strongly flattened above, subopaque, uniformly ochraceous, and in some examples the head, pronotum, antennae, and tibiae slightly reddish.

Head with the front strongly transverse, broadly, feebly concave between the antennal tubercles, which are widely separated and feebly elevated, finely, densely rugose or granulose, sparsely clothed with moderately long, inconspicuous, recumbent, pale yellow pubescence, with a few long, erect hairs around the eyes, and with a narrow, longitudinal groove, extending from epistoma to vertex; eyes separated from each other on the top by nearly three times the width of the upper lobe. Antenna one and one-fourth times as long as the body, basal joints robust, slightly rugose, sparsely clothed with long, semierect hairs, apical joints more slender, slightly flattened, rather densely clothed with short, recumbent, pale yellow pubescence, and all joints densely ciliate beneath; first joint finely scabrous, three-fourths as long as the third joint, which is slightly longer than the fourth, the following joints subequal in length, except the last, which is slightly shorter.

Pronotum as wide as long, subequal in width at base and apex, and widest at apical third; sides strongly, arcuately rounded anteriorly, obliquely narrowed posteriorly to near the base, where they are narrowly constricted; disk rather even, and slightly flattened; surface sparsely, irregularly granulose, sparsely clothed with moderately long, recumbent, whitish pubescence. Scutellum transversely oval, broadly rounded at apex, the surface slightly concave and sparsely pubescent.

Elytra five times as long as pronotum, and at base subequal in width to the pronotum at apical third; humeri strongly developed; sides strongly deflexed anteriorly, parallel from base to near the tips, which are separately, narrowly rounded; disk even, and feebly flattened; surface coarsely, densely, uniformly punctate, rather densely clothed with moderately long, semierect, pale yellow hairs, with a few longer, erect hairs intermixed.

Abdomen beneath finely, obsoletely punctate, with a few irregularly distributed asperities, and sparsely clothed with short recumbent, and long erect, pale yellow hairs intermixed; last segment broadly, arcuately emarginate at apex. Prosternum feebly, transversely rugose, with a few small asperities, and clothed with a few

inconspicuous hairs. Femora robust, feebly flattened, sparsely clothed with long, semierect, pale yellow hairs, and with numerous small, brown asperities on the underside, the middle and posterior pairs slightly longer, feebly arcuate, petiolate at bases, and strongly, abruptly clavate toward the apices. Tibiae slightly flattened, coarsely rugose, with numerous small, brown asperities, and densely clothed with long, semierect, yellowish hairs.

Female.—Differs from the male in having the antennae more slender, not quite so long as the body, outer joints cylindrical, the first joint only slightly shorter than the third joint, and subequal in length to the fourth; abdomen beneath smooth, without asperities, and the last segment broadly rounded at apex; legs less robust, and the femora and tibiae without asperities.

Length, 9–18 mm.; width, 2.2–4 mm.

Type locality.—L'Atalaye, Haiti.

Other locality.—St. Michel, Haiti.

Type, allotype, and paratypes.—U.S.N.M. No. 48707.

Paratypes.—In American Museum of Natural History.

Remarks.—Described from 45 examples (one male type): The type, allotype, and 37 paratypes, collected at light, at the type locality, between February 21 and March 8, 1928, by A. J. Poole; and 6 paratypes collected in a house at St. Michel, Haiti, between February 10 and 15, 1928, by the same collector.

There is considerable variation in size in the series examined, and also more or less variation in the shape of the pronotum. Many of the examples resemble the type, but in others the pronotum is more or less uneven, with an inconspicuous, longitudinal, median, smooth vitta, and the sides are regularly, arcuately rounded from base to apex.

METHIA PALLIDA, new species

Narrowly elongate, strongly flattened above, feebly shining, above uniformly pale yellow, except the eyes, which are black, beneath pale yellow, with the abdomen usually darker.

Head in front nearly square, flat, broadly, feebly concave between the antennal tubercles, which are broadly separated and feebly elevated, feebly, coarsely punctate, finely rugose, sparsely, uniformly clothed with short, semierect, yellow pubescence, and with a longitudinal carina extending from epistoma to occiput; eyes very large, nearly divided (connecting piece without facets), and nearly contiguous on the top. Antenna one and one-half times as long as the body, rather densely clothed with moderately long, semierect yellowish hairs; first joint robust, cylindrical, slightly enlarged toward apex, and one-half as long as the third joint, which is subequal in length to the fourth; eleventh joint subequal in length to the tenth.

Pronotum as wide as long, subequal in width at apex and base, and widest at middle; sides strongly constricted near base and apex, and arcuately rounded at middle; disk slightly flattened, even, broadly, transversely depressed near base and apex; surface finely, inconspicuously rugose, and sparsely clothed with long, inconspicuous, erect hairs. Scutellum as broad as long, feebly triangular, broadly rounded at apex, and the surface glabrous.

Elytra two-thirds as long as abdomen, four times as long as pronotum, and at base distinctly wider than pronotum at middle; sides gradually narrowed from base to the tips, which are separately, rather narrowly rounded; disk moderately flattened, surface rather densely, vaguely punctate, and sparsely clothed with short, inconspicuous, erect hairs.

Abdomen beneath finely, sparsely, vaguely punctate, rather densely clothed with long, inconspicuous, recumbent pubescence; last segment broadly, deeply, triangularly emarginate at apex. Prosternum vaguely rugose, clothed with a few inconspicuous hairs, and without a prosternal process; anterior coxae contiguous. Legs long; femora arcuately expanded near middle, and strongly flattened; tibiae subcylindrical.

Length, 4.2–8.6 mm.; width, 1.2–1.8 mm.

Type locality.—Port au Prince, Haiti.

Type and paratypes.—U.S.N.M. No. 43708.

Remarks.—Described from three examples (one type), all collected at light, at the type locality, by H. L. Dozier: The type, collected February 17, 1930, and labeled "Acc. 55-30"; one paratype, collected December 31, 1929; and one paratype, collected February 10, 1930, and labeled "Acc. 36-30." Sexes not determined.

This species is closely allied to *necydalea* Fabricius, but it can be separated from that species in being uniformly pale yellow above and in having the eyes practically divided.

BRITTONELLA, new genus

Head large, with the front vertical, and wider than long. Mandibles short, arcuate, and rather acute at apices. Ligula membranous and bilobed. Cheeks very short. Palpi 3-jointed, subequal in length, and the apical joints subtriangular. Antenna not distinctly longer than the body in both sexes, not spinose, not ciliate beneath; first joint subcylindrical, without a cicatrix at apex, and longer than the third joint. Antennal tubercles not spinose at apices. Eyes large, coarsely granulated, and deeply emarginate. Pronotum about as wide as long, unarmed at the sides and on disk. Scutellum moderately large. Elytra elongate, parallel, slightly flattened,

without eburneous spots, and spinose at apices. Abdominal segments unequal in length. Mesosternum broad, obliquely declivous in front, emarginate behind. Prosternal process not very narrow, and arcuately declivous posteriorly. Anterior coxae large, subglobose, moderately prominent, not angulated externally, and the cavities open posteriorly. Intermediate coxal cavities open externally. Legs unequal in length; tibiae not longitudinally carinate; femora spinose at apices, feebly clavate, but not petiolate at bases; posterior tarsus with the first joint scarcely as long as the following two joints united. Body not conspicuously pubescent.

Genotype.—*Brittonella chardoni*, new species.

This genus belongs to the tribe Hesperophanini and is allied to *Hesperophanes* Mulsant, but it differs from that genus in having the elytra spinose at apices, antennae not distinctly longer than the body, and not ciliate beneath, pronotum not transverse, femora spinose at apices, and the body only obsoletely pubescent.

I take great pleasure in dedicating this genus to Dr. N. L. Britton, eminent botanist, director for more than three decades of the New York Botanical Garden, chairman of the Porto Rico committee of the New York Academy of Sciences, to whose able and indefatigable services are due in large part the success of the natural history survey of Porto Rico.

BRITTONELLA CHARDONI, new species

Male.—Elongate, parallel, strongly flattened above, moderately shining, uniformly reddish brown, with the legs and antennae more yellowish brown.

Head with the front very short, strongly transverse, uneven, deeply, abruptly depressed between the antennal tubercles, which are narrowly separated and slightly elevated, feebly, coarsely, irregularly punctate, sparsely, irregularly clothed with erect, coarse, whitish hairs, and with a narrow, longitudinal groove between the antennal tubercles; eyes separated from each other on the top by about the width of the upper lobe. Antenna about as long as the body, basal joints sparsely clothed with long, erect hairs, apical joints densely clothed with short, recumbent, whitish pubescence; first joint rather robust, subcylindrical, feebly arcuate, slightly flattened beneath, slightly longer than the third joint, which is two-thirds longer than the fourth, the following joints subequal in length to the first.

Pronotum as wide as long, slightly wider at base than at apex; sides nearly parallel, rather strongly sinuate, more or less narrowed toward apex, and narrowly constricted at base; disk slightly uneven; surface more or less rugose, sparsely, coarsely, irregularly punctate, and sparsely clothed with moderately long, erect, whitish hairs.

Scutellum subtriangular, broadly rounded at apex, and densely clothed with recumbent, whitish pubescence.

Elytra four and one-half times as long as pronotum, and at base distinctly wider than pronotum; humeri rather feebly developed; sides nearly parallel from base to apical third, then arcuately narrowed to the tips, which are conjointly, broadly, arcuately emarginate, and armed with a long, acute spine at the outer margin of each elytron; disk even, and rather strongly flattened; surface coarsely, densely, uniformly punctate, sparsely clothed with short, recumbent, whitish hairs, with a few long, erect hairs intermixed.

Abdomen beneath feebly, finely punctate and sparsely clothed with long and short, fine, erect hairs; last segment broadly rounded at apex. Prosternum transversely rugose, and sparsely clothed with fine, erect, whitish hairs; prosternal process moderately narrow, arcuately expanded behind the coxal cavities, and broadly emarginate at apex. Anterior legs slightly shorter than middle and posterior pairs and sparsely clothed with moderately long, semierect hairs; femora feebly bispinose at apices, rather slender, slightly clavate, and the anterior pair slightly more robust; tibiae slender, straight, and subcylindrical.

Female.—Differs from the male in having the antenna considerably shorter than the body, the first joint more slender, nearly one-half longer than the third joint, which is slightly longer than the fourth, the fifth joint subequal in length to the first, and the following joints becoming gradually shorter.

Length, 17–20 mm.; width, 4.5–5 mm.

Type locality.—Mayaguez, Porto Rico.

Type, allotype, and paratype.—In American Museum of Natural History.

Paratype.—U.S.N.M. No. 43709.

Described from four examples, one male (type) and three females received from the American Museum of Natural History. All the specimens were collected at the type locality by R. H. Van Zwaluwenburg. The type was collected October 15, 1917 (Acc. No. 233–17), the allotype, August 29, 1914, and the paratypes, June 1, 1917 (Acc. No. 73–17), and October 5, 1917 (Acc. No. 228–17).

This species is named in honor of Carlos E. Chardon, Commissioner of Public Works in Porto Rico, in recognition of the encouragement of scientific research he has repeatedly displayed.

EBURIA LONGICORNIS, new species

Male.—Form rather short and robust. Above and beneath uniformly dark reddish brown, and each elytron ornamented with two pairs of elongate, eburneous spots.

Head transverse in front, deeply, transversely grooved behind the epistoma, feebly, longitudinally grooved between the antennal tubercles, which are slightly elevated and widely separated, surface somewhat uneven, coarsely, irregularly punctate, more or less rugose, and clothed with a few very short, inconspicuous hairs; eyes nearly divided, separated from each other on the top by twice the width of the upper lobe. Antenna slender, nearly four times as long as the body, three or four basal joints scabrous, and clothed with a few long hairs on the underside, following joints finely, densely punctate, and rather densely clothed with very fine, short recumbent, yellowish pubescence; first joint short, robust, and strongly clavate; third and fourth joints subequal in length, and united twice as long as the first, the following joints becoming gradually longer, and the eleventh joint as long as the preceding three joints united.

Pronotum nearly one and one-half times as wide as long, and feebly wider at apex than at base; sides arcuately rounded, and more strongly constricted at base than at apex; surface uneven, without distinct tubercles on disk or at lateral margins, coarsely, confluent alveolate-punctate, nearly glabrous on disk, but sparsely clothed at the sides with long, recumbent, whitish hairs.

Elytra at base about equal in width to pronotum at middle; humeri prominent, and slightly elevated; sides obliquely narrowed from base to the tips, which are broadly truncate, and each with a small, obtuse tooth at the sutural and lateral angles; surface strongly convex, densely punctate, the punctures becoming coarser and more confluent toward the bases, uniformly, sparsely clothed with short, erect, whitish hairs, and each elytron ornamented with two pairs of distinctly separated, elongate, eburneous spots, the outer spot of basal pair slightly shorter than the inner, and the inner spot of the median pair a little shorter than the outer one.

Body beneath sparsely clothed with long, inconspicuous hairs. Prosternum more coarsely punctured than rest of underside. Middle and posterior femora bispinose, with the spines subequal in length.

Female.—Differs from the male in having the sides of the elytra parallel to near the apices, antenna only slightly longer than the body, with only the basal joint coarsely punctate, and joints 3 to 11 nearly equal in length, pronotum with a small, obtuse, lateral tooth on each side at middle, and the underside of the body uniformly, finely punctate.

Length, 16-20 mm.; width, 5-6 mm.

Type locality.—Cuba (Central Florida, Province of Camaguey).

Other locality.—Baragua, Cuba.

Type and allotype.—U.S.N.M. No. 43710.

Paratype.—In S. C. Bruner collection.

Remarks.—Described from three examples, two males and one female: The type (male), collected at Central Florida (13 miles northeast of Camaguey), Province of Camaguey, May 15, 1922, by J. Rutz; the allotype, collected at Baragua, May 14, 1926, at light, by L. C. Scaramuzza (T. P. R. F. Ent. No. 3073); and one paratype, collected at Baragua, June 15, 1927, by C. F. Stahl and L. C. Scaramuzza.

This species is distinguished from the other West Indian species of this genus by its short, robust form, uniform dark reddish-brown color, and by the absence of conspicuous pubescence on the upper surface.

The paratype differs slightly from the type in having the eburneous spots of the basal pairs subequal in length, the median pairs of eburneous spots much shorter than the basal pairs, subequal in length, but with the inner spot of each median pair placed slightly in advance of the outer one, and the tips of the elytra broadly truncate, without a distinct spine at the sutural or lateral angles.

EBURIA BAHAMICAE, new species

Male.—Form elongate and similar to *stigma* Olivier. Above and beneath reddish brown, the color nearly concealed by whitish pubescence, and each elytron ornamented with two pairs of eburneous spots.

Head transverse in front, rather deeply, transversely grooved behind the epistoma, the grooves deeper on each side of middle, slightly concave between the antennal tubercles, which are slightly elevated and widely separated, surface slightly uneven, finely, rather densely punctate, and rather densely clothed with long, recumbent, yellowish-white pubescence; eyes deeply emarginate, separated from each other on the top by about the width of the upper lobe. Antenna slender, about twice as long as the body, first joint slightly more coarsely punctured than the following joints, and all joints rather densely clothed with short, recumbent, whitish pubescence, with a few long hairs on the underside of basal joints; first joint two-thirds as long as the third joint, robust, and rather strongly clavate; joints 3 to 10 subequal in length; eleventh joint slightly longer than tenth.

Pronotum about as long as wide, and slightly narrower at apex than at base; sides nearly parallel, sinuate, armed on each side with a large, acute spine, with a small glabrous callosity between the spine and apical angle; disk uneven, broadly, transversely flattened along anterior margin, a narrow, transverse (strongly angulated) groove near base, and ornamented with two round, dark brown tubercles in front of middle; surface coarsely punctate, more or less rugose, and densely clothed with recumbent, whitish pubescence, which con-

ceals the surface. Scutellum triangular-curved, and rather densely clothed with short, recumbent, whitish pubescence.

Elytra at base wider than pronotum at middle; humeri prominent and strongly elevated; sides nearly parallel from base to apical fifth, then arcuately narrowed to the tips, which are each bispinose, with the sutural spine much shorter than the lateral spine; surface moderately convex, rather densely, coarsely punctate basally, the punctures becoming obsolete toward the apices, rather densely clothed with short, recumbent, whitish hairs, which do not conceal the surface; each elytron with two pairs of eburneous spots, the outer spot of the basal pair very small, round, and sometimes reduced to the merest trace, the outer spot of median pair longer than the inner one, and the two spots usually in close contact along their entire length, with and obtuse, longitudinal costa at middle of each elytron, causing a slight depression or channel between the costa and sutural margin, and a similar depression toward the lateral margin.

Body beneath densely clothed with long, recumbent, whitish pubescence, which nearly conceals the surface, densely, finely punctate, except the prosternum, which is sparsely coarsely punctured. Middle and posterior femora bispinose, with the inner spine nearly twice as long as the outer one.

Female.—Differs from the male in having the antenna only slightly longer than the body, the eleventh joint not longer than the tenth, and the underside of the body uniformly, finely punctured.

Length, 14–20 mm.; width, 4–6 mm.

Type locality.—Mangrove Cay, Andros Islands.

Other localities.—Fresh Creek, Andros Islands; and “Bahamas.”

Type, allotype, and paratypes.—In American Museum of Natural History.

Paratypes.—U.S.N.M. No. 43711.

Remarks.—Described from 25 examples (one type): The type, allotype, and 21 paratypes, received from the American Museum of Natural History, and collected at the type locality during May and June, 1917, by William M. Mann; one paratype, collected at Fresh Creek, Andros Islands, during May and June, 1917, by the same collector; and one paratype labeled “Bahamas.”

This species is closely allied to *stigma* Olivier, but *stigma* can be separated from it in being more elongate, the sutural margins of the elytra densely clothed with conspicuous white pubescence, the eburneous spots on the elytra usually longer, and with a glabrous, black, longitudinal area in front of and behind each spot.

EBURIA CINEREOPILOSA, new species

Female.—Form elongate and subcylindrical. Above and beneath black or dark brown (except the legs, which are reddish yellow), but the color is concealed by the dense cinereous pubescence, which gives the body a bluish tinge, and each elytron ornamented with two pairs of elongate, eburneous spots.

Head transverse in front, broadly, transversely grooved behind the epistoma, narrowly, longitudinally grooved between the antennal tubercles, which are slightly elevated and widely separated, densely clothed with long, recumbent, whitish pubescence, which conceals the surface; eyes deeply emarginate, separated from each other on the top by twice the width of the upper lobe. Antennae broken, basal joint slightly more coarsely punctured than the following joints, which are rather densely clothed with short, recumbent, white pubescence; first joint robust, cylindrical, vaguely clavate, and about three-fourths as long as third joint, which is subequal in length to the fourth.

Pronotum as long as wide, and slightly narrower at apex than at base; sides nearly parallel, slightly narrowed anteriorly, broadly, arcuately constricted behind the lateral spines, armed on each side just behind the middle with a long, acute spine, and with a small, glabrous callosity between the spine and apical angle; surface rather even, very densely clothed with long, recumbent, white pubescence, which conceals the surface, and the disk ornamented with two round, black tubercles in front of middle. Scutellum triangular-curvilinear, and densely clothed with long, recumbent, white pubescence.

Elytra at base distinctly wider than pronotum at middle; humeri prominent and strongly elevated; sides nearly parallel from base to near apex, then arcuately narrowed to the tips, which are each bispinose, with the sutural spine much shorter than the lateral spine; surface strongly convex, densely clothed with long, recumbent, white pubescence, which conceals the surface, except where it is narrowly glabrous around the eburneous spots; each elytron ornamented with two pairs of elongate, eburneous spots, the spots of each pair in close contact along their entire length, basal spots about equal in length, and the inner spot of median pair slightly shorter than the outer spot.

Body beneath densely clothed with long, recumbent, white pubescence, which conceals the surface; surface finely, densely punctate, slightly more coarsely on the prosternum. Middle and posterior femora bispinose, with the inner spine at least twice as long as the outer spine.

Length, 20 mm.; width, 5 mm.

Type locality.—Guantanamo, Cuba.

Type.—In American Museum of Natural History. Collected on the San Carlos Estate, at light, April 24, 1914, by C. T. Ramsden.

Remarks.—Described from the type, a female.

This species resembles *tetrastalacta* White, but it can be distinguished from that species by its more cylindrical form and the dense white pubescence, which entirely conceals the surface.

EBURIA RAMSDENI, new species

Female.—Form broadly elongate. Above and beneath brownish black, but the color is concealed by the dense brownish-yellow pubescence (except a glabrous area around the eburneous spots), which gives it a pale brownish tinge, and each elytron ornamented with two pairs of small, rounded, eburneous spots.

Head transverse in front, deeply, transversely grooved behind the epistoma, narrowly, longitudinally grooved between the antennal tubercles, which are strongly elevated and widely separated; surface somewhat uneven, coarsely, irregularly punctate, densely, irregularly clothed with long, recumbent, brownish-yellow pubescence; eyes deeply emarginate, separated from each other on the top by about the width of the upper lobe. Antennae broken, basal joint scabrous, following joints finely, densely punctured, and rather densely clothed with short, recumbent, white pubescence, with numerous long, erect hairs on the underside of the joints; first joint robust, flattened on underside, slightly clavate, and one-half as long as the third joint, which is subequal in length to the fourth.

Pronotum slightly wider than long, and about equal in width at base and apex; sides arcuately rounded, strongly constricted at base, broadly swollen at apical angles, and armed on each side with a long, acute spine; disk uneven, feebly, transversely depressed along base, broadly flattened along apical margin, with a deep depression on each side near apical angle, and ornamented with two round, acute, black tubercles in front of middle; surface densely clothed with long, recumbent, brownish-yellow pubescence, which conceals the surface, except a very narrow, longitudinal, median line. Scutellum triangular, culvilinear, and densely clothed with long, recumbent, whitish pubescence.

Elytra at base about equal in width to pronotum at middle; humeri prominent and strongly elevated; sides nearly parallel from base to near apex, then arcuately narrowed to the tips, which are each bispinose, with the sutural spine slightly shorter than the lateral spine; surface moderately convex, densely clothed with long, recumbent, brownish-yellow pubescence (slightly denser and paler along sutural margins), nearly concealing the surface, except for a

broad area surrounding the eburneous spots, where the surface is nearly glabrous, and coarsely punctate, with a short, white hair arising from each puncture; each elytron ornamented with two pairs of widely separated, rounded, eburneous spots, the inner spot of the basal pair slightly longer than the other spots.

Abdomen beneath densely clothed with long, recumbent, brownish-yellow pubescence, which nearly conceals the surface; surface finely, densely punctate, more coarsely on the prosternum. Middle and posterior femora bispinose, with the two spines of each femur long and about equal in length.

Length, 21.5 mm.; width, 5.5 mm.

Type locality.—Guantanamo, Cuba.

Type.—In American Museum of Natural History. Collected at light, May 25, 1911, by C. T. Ramsden.

Remarks.—Described from the type, a female.

This species can be separated from the other described species of this genus from the West Indies by having the apical angles of the pronotum strongly swollen, and by the small rounded eburneous spots on the elytra being broadly surrounded by a nearly glabrous blackish area.

EBURIA PORTORICENSIS, new species

Female.—Form rather broadly elongate. Above and beneath reddish brown, the legs and antennae slightly paler, surface nearly concealed by the dense, brownish-white pubescence, except around the eburneous spots, where it is nearly glabrous, and each elytron ornamented with two pairs of small, oblong, eburneous spots.

Head transverse in front, deeply, arcuately, transversely grooved behind the epistoma, narrowly, longitudinally grooved between the antennal tubercles, which are strongly elevated and widely separated, densely clothed with long, recumbent, yellowish-white pubescence, which conceals the surface; eyes deeply emarginate, separated from each other on the top by about the width of the upper lobe. Antenna slightly longer than the body, basal joint slightly more coarsely punctured than following joints, and all joints rather densely clothed with short, recumbent, whitish pubescence, with numerous long, erect hairs on the underside of joints; first joint robust, strongly clavate, and one-half as long as the third joint, which is slightly longer than the fourth; joints 4 to 10 subequal in length; eleventh joint slightly longer than the tenth.

Pronotum as long as wide, and slightly narrower at apex than at base; sides sinuate, parallel posteriorly, feebly, obliquely narrowed anteriorly, and armed on each side with a long, acute spine near middle, and a large, obtuse, glabrous callosity near the apical angle;

disk with a narrow, transverse depression in front of basal margin, apical third broadly, transversely concave, and ornamented with two small, round, black tubercles in front of middle; surface densely clothed with long, recumbent, brownish-white pubescence, which conceals the surface. Scutellum triangular, curvilinear, and densely clothed with long, recumbent, brownish-white pubescence.

Elytra at base distinctly wider than pronotum at middle; humeri prominent and strongly elevated; sides nearly parallel from base to near apices, then arcuately narrowed to the tips, which are each bispinose, with the sutural spine distinctly shorter than the lateral spine; surface moderately convex, densely clothed with long, recumbent, whitish pubescence, which nearly conceals the surface, except a broad, nearly glabrous area surrounding the eburneous spots, where the surface is coarsely punctate, with a short, white hair arising from each puncture; each elytron ornamented with two pairs of small, oval, widely separated, eburneous spots, the outer spot of the median pair slightly in advance of the inner spot.

Body beneath rather densely clothed with long, recumbent, white pubescence, not entirely concealing the surface, finely, densely punctate, with a few coarser punctures intermixed. Middle and posterior femora bispinose, with the inner spine slightly longer than the outer one.

Length, 20 mm.; width, 5 mm.

Type locality.—Guayama, Porto Rico.

Type.—In American Museum of Natural History. Labeled "Aguirre Centr. (Guayama) P. R., April 15, 1930, Cornell Univ. Lot 795, sub. 31."

Remarks.—Described from the type, a female.

This species is allied to *tetrastalacta* White, but can be distinguished from that species by the denser and longer whitish pubescence on the dorsal surface, the eburneous spots on the elytra widely separated, and the outer spot of each median pair placed in advance of the inner spot.

EBURIA CUBAE, new species

Male.—Form broadly elongate. Above and beneath uniformly brownish yellow, nearly glabrous, and each elytron ornamented with two pairs of small, oval, eburneous spots.

Head transverse in front, deeply, transversely, triangularly depressed behind the epistoma, narrowly, longitudinally grooved between the antennal tubercles, which are widely separated but scarcely elevated; surface slightly uneven, densely, confluent punctate, more or less scabrous, and sparsely clothed with short, inconspicuous, recumbent hairs; eyes deeply emarginate, separated from

each other on the top by about three times the width of the upper lobe. Antenna slender, about one and one-half times as long as the body, three or four basal joints sparsely punctate (first joint scabrous), sparsely clothed with short, white hairs, with numerous long, erect hairs intermixed, following joints finely, densely punctate, and densely clothed with very short, recumbent pubescence; first joint robust, slightly flattened on top, strongly clavate, and about one-half as long as the third joint, which is slightly longer than the fourth; joints 4 to 10 subequal in length; eleventh joint distinctly longer than tenth.

Pronotum vaguely wider than long, and about equal in width at base and apex; sides strongly sinuate, strongly, arcuately constricted near posterior angles, and armed on each side at middle with a vague, broadly obtuse tubercle of the same color as rest of surface, and a smaller callosity of the same color between the tubercle and the apical angle; disk uneven, ornamented with two elongate, black tubercles in front of middle; surface rather finely, confluent punctate or scabrous, and sparsely clothed with short, inconspicuous hairs. Scutellum broadly triangular, curvilinear, and sparsely clothed with short, inconspicuous hairs.

Elytra at base slightly wider than pronotum at middle; humeri prominent and strongly elevated; sides nearly parallel from base to apical fourth, then arcuately narrowed to the tips, which are separately, obliquely truncate, with a small spine at the sutural angle; surface rather strongly convex, rather coarsely, confluent punctate, with numerous distinct granular elevations in the sutural regions, and sparsely clothed with short, inconspicuous hairs; each elytron ornamented with two pairs of small, oval, widely separated, eburneous spots, inner spot of basal pair slightly wider and longer than outer one, and inner spot of median pair in advance of the outer spot.

Body beneath finely, densely punctate, and densely clothed with moderately long, recumbent, inconspicuous hairs. Middle and posterior femora unispinose.

Female.—Differs from the male in having the antenna about as long as the body, the joints becoming gradually shorter toward the tip, and the eleventh joint subequal in length to the tenth.

Length, 10–19 mm.; width, 2.75–5 mm.

Type locality.—Baragua, Cuba.

Other localities.—Central Constancia, Guantanamo, and Central Jaronu, Cuba.

Type, allotype, and paratypes.—U.S.N.M. No. 43712.

Paratypes.—In American Museum of Natural History and in S. C. Bruner collection.

Remarks.—Described from 8 examples (one type): The type, allotype, and 2 paratypes, collected at the type locality, at light, October 24, 1925, by C. F. Stahl (T. P. R. F. Ent. No. 229); 2 paratypes collected at Central Constancia, May, 1914, by J. F. Merrill; 1 paratype, collected at Central Jaronu (north coast of Camaguey Province), April 4, 1926, by B. T. Barreto; and 1 paratype, collected at Guantanamo, at light, by C. T. Ramsden.

This species can be easily separated from the other described West Indian species of this genus by its uniform brownish-yellow color, by the unispinose tips of the femora, and by the arrangement of the eburneous spots on the elytra.

EBURIA ELONGATA, new species

Female.—Form narrowly elongate, subcylindrical. Above and beneath uniformly black, strongly shining, each elytron ornamented with three or four eburneous spots.

Head transverse in front, deeply, transversely, triangularly depressed behind the epistoma, narrowly, deeply, longitudinally grooved between the antennal tubercles, which are widely separated and moderately elevated; surface sparsely, irregularly punctate, irregularly clothed with long, recumbent, white pubescence; eyes deeply emarginate, separated from each other on the top by nearly three times the width of the upper lobé. Antenna slender, about as long as the body, three or four basal joints sparsely, coarsely punctate, sparsely clothed with short, white hairs, with numerous long, erect hairs intermixed, following joints finely, densely punctate, and rather densely clothed with short, recumbent, whitish pubescence; first joint robust, strongly clavate, and about two-thirds as long as the third joint, which is slightly longer than the fourth; joints 4 to 11 subequal in length.

Pronotum as long as wide, and about equal in width at base and apex; sides sinuate, slightly swollen at middle, but without a distinct spine; disk somewhat uneven, and ornamented with two round, feeble, glabrous callosities in front of middle, and a longitudinal, glabrous, median area; surface rather densely, coarsely, irregularly punctate, and rather densely, irregularly clothed with long, recumbent, whitish pubescence, except on the median, glabrous area. Scutellum triangular, curvilinear, and densely clothed with recumbent, whitish pubescence.

Elytra at base distinctly wider than pronotum at middle; humeri feebly elevated; sides nearly parallel from base to near apices, then arcuately narrowed to the tips, which are separately, obliquely truncate, with a distinct spine at lateral angle, and an obsolete spine at sutural angle; surface moderately convex, coarsely, rather densely

punctate on basal halves, but the punctures becoming more obsolete toward the apices, and narrowly, densely clothed along the sutural margins with long, recumbent, white pubescence, the pubescent vittae becoming slightly broader toward the apices; each elytron ornamented with two pairs of eburneous spots (outer spot of median pair missing in type), inner spot of basal pair at least twice as long as the outer one, and the two spots narrowly separated at base, outer spot of median pair (when present) much smaller than the inner one, and the two spots distinctly separated.

Body beneath finely, densely punctate, except the prosternum, which is sparsely, coarsely punctured, and rather densely, irregularly clothed with long, recumbent, silvery-white pubescence. Middle and posterior femora vaguely bispinose, with the inner spine short, and the outer one scarcely developed.

Length, 14–15.5 mm.; width, 3–3.5 mm.

Type locality.—Guantanamo, Cuba.

Type and paratype.—In American Museum of Natural History.

Paratype.—U.S.N.M. No. 43713.

Remarks.—Described from three examples (one type), probably all females, received from the American Museum of Natural History: The type, collected June 1, 1908, by S. Cardos; and two paratypes, labeled "Guantanamo, Rio Seco, May 31 and June 1, 1910, S. Cardos."

This species is allied to *decemmaculata* Fabricius, but it can be easily separated from that species in being more narrowly elongate and subcylindrical, and in the fact that the elytra have a distinct white pubescent vitta along the sutural margins.

ELAPHIDION SPLENDIDUM, new species

Female.—Broadly elongate, moderately convex above, and similar in form to *spinicorne* Drury. Above and beneath uniformly reddish brown, strongly shining, and irregularly clothed with recumbent, white pubescence.

Head sparsely, coarsely, irregularly punctate, rather densely, irregularly clothed with moderately long, recumbent, white pubescence, front distinctly wider than long, nearly flat, with a narrow, longitudinal groove between the antennal tubercles, which are widely separated but not elevated; eyes deeply emarginate, separated from each other on the top by nearly three times the width of the upper lobe. Antenna as long as the body, four or five basal joints coarsely punctate, sparsely clothed with moderately long, recumbent, white hairs, with a few long, erect hairs on the underside of the joints, the following joints finely, densely punctate, rather densely clothed with short, recumbent, white pubescence, and joints 3 to 10 bispinose

at apices; first joint robust, rather strongly clavate, and subequal in length to the third joint, which is longer than the fourth, the following joints becoming gradually shorter; eleventh joint subequal in length to the tenth.

Pronotum wider than long, and feebly wider at base than at apex; sides rather strongly, arcuately rounded; disk nearly even, and ornamented with distinct, smooth, glabrous spots as follows: A longitudinal, median spot, slightly expanded at middle, and extending from anterior margin to near base, and five or six rounded spots on each side; surface uniformly, densely clothed with moderately long, recumbent, white pubescence, which conceals the surface, except on the glabrous spots. Scutellum broadly triangular, curvilinear, and densely clothed with recumbent, white pubescence.

Elytra three times as long as pronotum, and at base slightly wider than pronotum at middle; sides vaguely narrowed from base to near the tips, which are separately, broadly truncate, bispinose, with the lateral spine much longer than the sutural one; surface sparsely, irregularly, coarsely punctate, the punctures becoming smaller toward apices, and irregularly clothed with patches of moderately long, dense, recumbent, white hairs.

Abdomen beneath finely, densely punctate at sides, smooth and glabrous at middle, densely clothed at the sides with long, recumbent, white pubescence, with a few long, inconspicuous, erect hairs intermixed, a round, glabrous spot at the sides of each segment except the last, which is vaguely, broadly emarginate at apex. Prosternum smooth, glabrous at middle, and densely clothed with long, recumbent, white pubescence at the sides; prosternal process flat, broadly, arcuately expanded posteriorly, the apex rounded, and abruptly declivous. Mesosternum broad, and abruptly declivous in front. Femora slender, slightly clavate toward tips, the middle and posterior pairs bispinose at apices, with the inner spine slightly longer than the outer one.

Male.—Differs from the female in having the antenna slightly longer than the body, basal joints more coarsely punctured, the last joint subappendiculate, and armed with a minute spine on inner side at middle, prosternum rather densely, finely punctate, and pubescent at middle, and the last abdominal segment shorter, and more broadly rounded at apex.

Length, 13.5–17 mm.; width, 3.6–4.8 mm.

Type locality.—Port au Prince, Haiti.

Other localities.—Jeremie, Haiti; Sanchez, Dominican Republic; "Sto. Tomás, Peninsula de Zapata, Cuba."

Type, allotype, and paratype.—U.S.N.M. No. 43714.

Paratypes.—In American Museum of Natural History and in Museum of Comparative Zoology.

Remarks.—Described from 6 examples, 1 male and 5 females: The type (female), collected at Port au Prince, Haiti, March, 1925, by G. N. Wolcott (Acc. No. 262-25); allotype, collected at "Sto. Tomás, Peninsula de Zapata, Cuba," between May 5 and 9, 1927, by S. C. Bruner and J. Acuña; one paratype, collected at Jeremie, Haiti, April 11, 1917; two paratypes, received from the American Museum of Natural History, collected at Sanchez, Dominican Republic, during June, 1915, by F. E. Watson; and one paratype, received from the Museum of Comparative Zoology, labeled "Hayti, P. R. Uhler."

This species is closely allied to *spinicorne* Drury, but it can be separated from that species by being more strongly shining and by the pubescence on the elytra being white and irregularly separated into distinct spots.

ELAPHIDION MANNI, new species

Female.—Broadly elongate, moderately convex above, and similar in form to *spinicorne* Drury. Above and beneath uniformly dark reddish brown, moderately shining, and irregularly clothed with recumbent, gray pubescence.

Head very sparsely, coarsely punctate, longitudinally rugose, rather densely, irregularly clothed with moderately long, recumbent, grayish pubescence, front distinctly wider than long, nearly flat between the antennal tubercles, which are widely separated but not elevated; eyes deeply emarginate, separated from each other on the top by twice the width of the upper lobe. Antenna not quite as long as the body, four basal joints coarsely punctate, sparsely clothed with moderately long, recumbent, white hairs, with a few long, erect hairs on the underside of the joints, the following joints finely, densely punctate, rather densely clothed with short, recumbent, white pubescence, and joints 3 to 10 bispinose at apices; first joint robust, strongly clavate, slightly flattened on top, and subequal in length to the third joint, which is slightly longer than the fourth, the following joints becoming gradually shorter; eleventh joint subequal in length to the tenth, and slightly expanded near apex.

Pronotum slightly wider than long, and about equal in width at base and apex; sides rather strongly, arcuately rounded; disk uneven, and ornamented with five smooth, glabrous, elevated spots as follows: A narrow, longitudinal, median spot, not extending to anterior margin or base, and two spots on each side, a rounded one in front of middle, and a narrow, elongate one near base; surface coarsely, sparsely punctate, and rather densely clothed with long,

wavy, recumbent, grayish pubescence, which does not quite conceal the surface. Scutellum broadly triangular, curvilinear, and densely clothed with recumbent, grayish pubescence.

Elytra three and one-half times as long as pronotum, and at base slightly wider than pronotum at middle; sides parallel from base to near the tips, which are separately, broadly truncate, bispinose, with the lateral spine much longer than the sutural one; surface sparsely punctate, the punctures coarse on basal halves, but becoming more obsolete toward the apices, and rather densely, irregularly clothed with moderately long, recumbent, grayish pubescence, not concealing the surface, but giving it a variegated appearance.

Abdomen beneath sparsely, irregularly punctate, rather densely clothed with long, recumbent, white pubescence, with a few long, erect hairs intermixed, but the pubescence not concealing the surface; last segment broadly rounded, and feebly emarginate at apex. Prosternum sparsely, coarsely punctate, rather densely clothed with long, recumbent, white pubescence; prosternal process flat, obliquely expanded to apex, which is truncate, and abruptly declivous. Mesosternum obliquely declivous in front. Femora slender, slightly clavate toward tips, and the middle and posterior pairs bispinose at apices, with the inner spine considerably longer than outer one.

Length, 15 mm.; width, 4 mm.

Type locality.—Fresh Creek, Andros Islands.

Type.—In American Museum of Natural History. Collected during May–June, 1917, by William M. Mann.

Remarks.—Described from the type, a female.

This species is closely allied to *conspersum* Newman, but it can be separated from that species in having the pronotum more uneven, the pubescence longer and more wavy, and the pubescence on the elytra gray and more uniformly distributed.

ELAPHIDION BIDENS (Fabricius)

Stenocorus bidens FABRICIUS, Mantissa insectorum, vol. 1, no. 8, p. 143, 1787 (not *bidens* Olivier, Newman, Chevrolat).

Cerambyx bispinosus GMELIN, in Linnaeus, Systema naturae, ed. 13, vol. 1, pt. 4, No. 322, p. 1859, 1790.

This species was described by Fabricius (1787) from South America, and Gmelin (1790) redescribed the same species under the name of *bispinosus*, citing *bidens* Fabricius (op. cit.). The species was included by Chevrolat (1862) in his Coleoptera of the island of Cuba, but his specimens were compared with the type of *bidens* Olivier, which is not the *bidens* described by Fabricius, but which is given by Aurivillius¹ as a synonym of *irroratum* Linnaeus. This

¹ Catalogus Coleopterorum, pt. 39, p. 87, 1912.

is a South American species and should not be included in lists of West Indian Coleoptera.

ELAPHIDION ROTUNDIPENNE, new species

Male.—Broadly elongate, moderately convex above, and similar in form to *incertum* Newman. Above and beneath uniformly dark reddish brown, feebly shining, and irregularly clothed with gray pubescence.

Head sparsely, coarsely, irregularly punctate, sparsely, irregularly clothed with long, recumbent, grayish pubescence, front distinctly wider than long, nearly flat, with a feeble, longitudinal groove between the antennal tubercles, which are widely separated, and feebly elevated; eyes deeply emarginate, separated from each other on the top by a little more than the width of the upper lobe. Antenna one and one-half times as long as the body, basal joints sparsely punctate, and sparsely clothed with short, recumbent hairs, with a few long, erect hairs on the underside of the joints, apical joints finely, densely punctate, and densely clothed with short, recumbent, whitish pubescence, joints 3 and 4 unispinose at apices, the following joints bispinose, but the spines becoming very short on the apical joints; first joint robust, strongly clavate, subequal in length to the fourth joint, which is slightly shorter than the third, the following joints subequal in length to the third; eleventh joint slightly longer than the tenth, and more or less flattened.

Pronotum slightly wider than long, and about equal in width at base and apex; sides feebly, arcuately rounded; disk uneven, and ornamented with an elongate, irregular, median, glabrous space, and a rounded, irregular, glabrous space on each side in front of middle; surface sparsely, coarsely, irregularly punctate, and sparsely, irregularly clothed with long, recumbent, gray pubescence. Scutellum broadly triangular, curvilinear, and densely clothed with recumbent, gray pubescence.

Elytra not quite three times as long as pronotum, and at base about equal in width to pronotum at middle; humeral angles broadly rounded; sides nearly parallel from base to apical sixth, then arcuately narrowed to the tips, which are broadly rounded, and not spinose; surface densely, irregularly punctate, the punctures coarse on basal halves, but becoming smaller toward apices, and irregularly clothed with patches of long, recumbent, gray pubescence, which does not conceal the surface.

Abdomen beneath sparsely, finely punctate, rather densely clothed with long, recumbent, gray pubescence, with a few long, erect hairs intermixed, but the pubescence not quite concealing the surface; last segment broadly rounded at apex. Prosternum sparsely, coarsely

punctate, densely clothed with long, recumbent, gray pubescence, except on prosternal process and along anterior margin; prosternal process rather narrow, slightly expanded toward apex, which is truncate, and abruptly declivous. Mesosternum broad, depressed, and abruptly declivous in front. Legs rather densely clothed with long, recumbent and erect, grayish hairs intermixed; femora rather robust, strongly expanded at middle, but not spinose at apices.

Length, 16 mm.; width, 4 mm.

Type locality.—Haine, Dominican Republic.

Type.—U.S.N.M. No. 43715. Collected in 1920, by G. N. Wolcott.

Remarks.—Described from the type, a male.

This species can be distinguished from the other described species of *Elaphidion* found in the West Indies by the following combination of characters: Third and fourth antennal joints unispinose, prosternal process abruptly declivous at apex, elytra broadly rounded at apices and not spinose, and the femora not spinose at apices.

ELAPHIDION CAYAMAE, new species

Female.—Narrowly elongate, subcylindrical, strongly convex above, and similar in form to *villosum* Fabricius. Above and beneath uniformly dark reddish brown, feebly shining, and irregularly clothed with recumbent, gray pubescence.

Head sparsely, coarsely, irregularly punctate, longitudinally rugose, sparsely clothed with long, recumbent, yellowish-white pubescence, with a few long, erect hairs intermixed, front distinctly wider than long, feebly concave between the antennal tubercles, which are widely separated, and slightly elevated; eyes deeply emarginate, separated from each other on the top by twice the width of the upper lobe. Antenna not quite so long as the body, basal joints coarsely, irregularly punctate, sparsely clothed with long, recumbent, white pubescence, with a few long, erect hairs on the underside of the joints, apical joints finely, densely punctate, and densely clothed with short, recumbent, white pubescence, joints 3 to 7 unispinose at apices, the spines on joints 3 and 4 very long; first joint robust, rather strongly clavate, and slightly longer than the third joint; fourth joint about one-third as long as the third, following joints variable in length; eleventh joint nearly twice as long as the tenth, and slightly flattened.

Pronotum as wide as long, and about equal in width at base and apex; sides rather strongly, arcuately rounded; disk strongly convex, even, and ornamented with four inconspicuous, glabrous spots, two at base, and two in front of middle; surface coarsely, irregularly, confluent punctate, sparsely clothed with long, recumbent, grayish

pubescence, which is denser in some places. Scutellum broadly triangular, curvilinear, and rather densely clothed with recumbent, gray pubescence.

Elytra three and one-half times as long as pronotum, and at base slightly wider than pronotum at middle; humeral angles broadly rounded; sides vaguely narrowed from base to the tips, which are separately, broadly truncate, bispinose, with the outer spine much longer than the inner one; surface rather densely, coarsely punctate, the punctures becoming smaller toward the apices, and irregularly clothed with long, recumbent, gray pubescence, which does not conceal the surface.

Abdomen beneath finely, sparsely punctate at sides, smooth and nearly glabrous at middle, densely clothed at the sides with long, recumbent, white pubescence, with a few long, erect hairs intermixed; last segment broadly rounded at apex. Prosternum very coarsely, confluent punctate, sparsely clothed with inconspicuous, erect hairs, except on the prosternal process and along anterior margin, where the surface is smooth and nearly glabrous; prosternal process rather narrow, slightly expanded toward apex, which is subtruncate, and abruptly declivous. Mesosternum broad, flat, and strongly declivous in front. Legs rather densely, irregularly clothed with long, recumbent and erect, grayish hairs, causing the surface to have a mottled appearance; femora robust, slightly clavate toward apices, and the middle and posterior pairs bispinose at apices, with the inner spine considerably longer than the outer one.

Length, 15–16 mm.; width, 3.6–4 mm.

Type locality.—Cayamas, Cuba.

Other locality.—Colon, Cuba.

Type.—U.S.N.M. No. 43716. Collected March 14, by E. A. Schwarz.

Paratype.—Museum of Comparative Zoology. Collected May 9, 1923, at Colon, Cuba, by Doctor Comas.

Remarks.—Described from two females (type and paratype).

This species can be distinguished from the other described species of this genus from the West Indies in having the fourth joint of the antenna very short, scarcely longer than the second joint, but armed with a very long spine.

ELAPHIDION TUBERCULICOLLE, new species

Male.—Rather broadly elongate, slightly flattened above, similar in form to *guttiventre* Chevrolat, only more narrowly elongate. Above and beneath uniformly brownish black, feebly shining, elytra more or less costate posteriorly, and clothed with white and brownish-yellow pubescence.

Head sparsely, coarsely punctate, densely clothed with long, recumbent, white and brownish-yellow hairs intermixed, which conceal the surface, front distinctly wider than long, with a longitudinal costa on vertex, broadly concave between the antennal tubercles, which are widely separated and slightly elevated; eyes deeply emarginate, separated from each other on the top by nearly three times the width of the upper lobe. Antenna one and one-half times as long as the body, basal joints sparsely, coarsely punctate, rather densely clothed with long, recumbent, white and brownish-yellow hairs intermixed, with a few long, erect hairs on the underside of the joints, apical joints densely, finely punctate, and densely clothed with short, recumbent, white pubescence, joints 3 to 5 unispinose at apices; first joint robust, strongly clavate, subequal in length to the third joint, which is distinctly longer than the fourth, the following joints subequal in length to the third; eleventh joint slender, and slightly longer than the tenth.

Pronotum distinctly wider than long, and about equal in width at base and apex; sides feebly, arcuately rounded, and subtuberculate at middle; disk somewhat uneven, and ornamented with glabrous spots as follows: A narrow, longitudinal, median vitta, extending from anterior margin to base, and three glabrous tubercles on each side, one at base, and two placed transversely in front of middle, of which the outer tubercle is the longest; surface coarsely, irregularly punctate, densely clothed with long, recumbent, white and brownish-yellow pubescence, which conceals the surface. Scutellum broadly triangular, curvilinear, glabrous at middle, and clothed at sides with long, recumbent hairs.

Elytra four times as long as pronotum, and at base slightly wider than pronotum at middle; humeral angles broadly rounded; sides vaguely narrowed from base to the tips, which are separately, deeply emarginate, bispinose, with the lateral spine much longer than the sutural one; surface coarsely, confluent punctate, the punctures finer and distinctly separated toward the apices, rather densely clothed with moderately long, recumbent, brownish-yellow hairs, with numerous short, recumbent white hairs intermixed, and each elytron ornamented with a glabrous costa behind the middle, and an inconspicuous, elongate spot of dense, white pubescence in front of middle.

Abdomen beneath sparsely, finely punctate, densely clothed with long, recumbent, brownish-yellow and white pubescence, with a few long, erect hairs intermixed, median part of segments more sparsely pubescent; last segment broadly rounded and vaguely emarginate at apex. Prosternum rather finely, densely pubescent, except on prosternal process and along anterior margin; prosternal process rather broad, slightly expanded toward apex, which is truncate, and

abruptly declivous. Mesosternum broad, flat, and abruptly declivous in front. Legs densely, irregularly clothed with long, recumbent and erect, yellowish and whitish pubescence intermixed, causing the surface to have a mottled appearance; femora robust, slightly expanded near middle, the middle and posterior pairs feebly bispinose at apices, with the inner spine slightly longer than the outer one.

Female.—Differs from the male in having the antenna only slightly longer than the body, the eleventh joint broad, and subequal in length to the tenth, prosternum more coarsely punctured at middle, and the last abdominal segment broadly rounded at apex.

Length, 12–18 mm.; width, 2.8–4.8 mm.

Type locality.—Cayamas, Cuba.

Type, allotype, and paratypes.—U.S.N.M. No. 43717.

Paratype.—In American Museum of Natural History.

Remarks.—Described from eight examples (one type), all collected at the type locality, during January, February, and March, by E. A. Schwarz.

This species is easily distinguished from the other described West Indian species of this genus having the third and fourth joints of the antennae unispinose, and the prosternum abruptly declivous at the apex, by the distinct tubercles on the pronotum.

The specimens examined vary considerable in size and show a slight variation in the white pubescent markings on the basal halves of the elytra; in some examples this spot is quite distinct, whereas in others it is more or less obsolete.

ELAPHIDION CUBAE, new species

Female.—Short, rather narrowly elongate, moderately convex above, and similar in form to *nanum* Fabricius. Above black, rather strongly shining, and irregularly clothed with whitish pubescence; beneath brownish black.

Head coarsely, confluent punctate, longitudinally rugose, sparsely clothed with long, recumbent, yellowish-white pubescence, front distinctly wider than long, flat between the antennal tubercles, which are widely separated, but not elevated; eyes deeply emarginate, separated from each other on the top by twice the width of the upper lobe. Antenna not quite so long as the body, basal joints sparsely, coarsely punctate, sparsely clothed with long, recumbent, yellowish-white pubescence, with a few long, erect hairs on the underside of the joints, apical joints broader, finely, densely punctate, and rather densely clothed with short, recumbent, yellowish-white pubescence; joints 3 to 10 unispinose at apices, the spines becoming very small on outer joints; first joint robust, feebly clavate, slightly longer than

the third joint, which is a little longer than the fourth, the following joints subequal in length.

Pronotum about as wide as long, and about equal in width at base and apex; sides rather strongly, arcuately rounded; disk even, with an inconspicuous, glabrous, elongate, median vitta, not extending to base or anterior margin; surface coarsely, irregularly, confluent punctate, sparsely clothed with long, recumbent, whitish pubescence, which is denser in some places. Scutellum broadly triangular, curvilinear, and densely clothed with long, recumbent whitish pubescence.

Elytra three and one-half times as long as pronotum, and at base slightly wider than pronotum at middle; humeral angles broadly rounded; sides feebly narrowed from base to the tips, which are separately, deeply emarginate, bispinose, the spines subequal in length and not very widely separated; surface rather densely punctate, the punctures coarse on basal regions, but becoming finer toward the apices, rather densely, irregularly clothed with long, recumbent, whitish pubescence, with numerous long, erect hairs intermixed and with a more or less distinct, irregular, subglabrous spot on each elytron near middle, and a similar, but smaller, spot at basal fourth near the sutural margins.

Abdomen beneath sparsely, finely punctate, rather densely clothed at sides with long, recumbent and erect, white hairs, more sparsely clothed on median parts; last segment broadly rounded at apex. Prosternum coarsely, sparsely punctate, rather densely clothed with long, whitish pubescence, especially at the sides; prosternal process rather narrow, slightly expanded toward apex, which is broadly rounded, and abruptly declivous. Mesosternum broad, and obliquely declivous in front. Legs sparsely clothed with long, recumbent and erect, whitish hairs; femora robust, rather strongly clavate toward the tips, which are not spinose.

Length, 10 mm.; width, 2.8 mm.

Type locality.—Santiago, Cuba.

Type.—U.S.N.M. No. 43718. A unique female collected October 10, 1903, by Wirt Robinson.

Remarks.—Described from the type.

This species resembles *nanum* Fabricius in a number of ways, but it can be easily separated from that species in being uniformly black above, third and fourth antennal joints armed with a long spine at their tips, each elytron bispinose at apex, and the prosternal process abruptly declivous at the apex.

ELAPHIDION FASCIATUM, new species

Male.—Broadly elongate, slightly flattened above, and similar in form to *inermis* Newman. Above and beneath reddish black, rather

strongly shining, legs and antennae slightly more reddish, and the elytra ornamented with a transverse, zigzag, white pubescent fascia.

Head coarsely, densely, uniformly punctate, very sparsely clothed with short, recumbent, white hairs, front wider than long, nearly flat, with a narrow, longitudinal groove between the antennal tubercles, which are widely separated and slightly elevated; eyes deeply emarginate, separated from each other on the top by twice the width of the upper lobe. Antenna slightly longer than the body, basal joints coarsely punctate, sparsely clothed with long, recumbent, white pubescence, with a few long, erect hairs on the underside of the joints, apical joints finely, densely punctate, rather densely clothed with short, recumbent pubescence; joints 3 and 4 unispinose at apices; joints 5 to 7 feebly bispinose, the following joints vaguely unispinose; first joint robust, strongly clavate, subequal in length to the third joint, and each of the following joints about equal in length to the third joint.

Pronotum distinctly wider than long, and about equal in width at base and apex; sides rather strongly, arcuately rounded; surface even, moderately convex, coarsely alveolate-punctate, with a minute hair at middle of each puncture, and clothed on each side along lateral margin with a narrow, dense, white pubescent vitta, which does not extend to anterior margin, but for a short distance on each side along base. Scutellum broadly triangular, curvilinear, and densely clothed with long, recumbent, white pubescence, except for a very narrow, longitudinal, glabrous line at middle.

Elytra nearly four times as long as pronotum, and at base slightly wider than pronotum at middle; humeral angles broadly rounded; sides feebly narrowed from base to apical fifth, then arcuately narrowed to the tips, which are separately, deeply emarginate, bispinose, with the lateral spine much longer than the sutural one; surface rather densely punctate, the punctures coarse on basal halves, but becoming finer toward the apices, a short, semierect, white hair arising from each puncture, and each elytron ornamented with a spot of dense, white pubescence at humeral angle, and a narrow, transverse, zigzag fascia of similar pubescence at middle.

Abdomen beneath sparsely finely punctate, and sparsely clothed with long, recumbent, whitish pubescence; last segment broadly rounded at apex. Prosternum coarsely, irregularly, confluent punctate, densely clothed with long, recumbent, white pubescence, except along the anterior margin; prosternal process very narrow, and arcuately declivous posteriorly. Mesosternum broad, flat between the coxal cavities, and rather abruptly declivous in front. Legs sparsely clothed with long, recumbent and semierect, white

pubescence; femora feebly expanded near middle, but not spinose at the tips.

Length, 10–12 mm.; width, 3.2–3.6 mm.

Type locality.—Central Constancia, Cuba.

Other locality.—Guantanamo, Cuba.

Type.—U.S.N.M No. 43719. Collected by J. F. Merrill.

Paratype.—In American Museum of Natural History. Collected at Guantanamo, Cuba, June 22, 1914, by C. T. Ramsden.

Remarks.—Described from two males (type and paratype).

This species is closely allied to *transversum* White, but it differs from that species in having the sides of the pronotum clothed with white pubescence, and the apical part of each elytron not ornamented with a gray pubescent spot.

ELAPHIDION ALBOMACULATUM Champlain and Knull

Elaphidion albomaculatum CHAMPLAIN and KNULL, Ent. News, vol. 33, p. 146, 1922.

This species was described from Miami, Fla., but among the material received from the American Museum of Natural History was a specimen collected at Holguim, Cuba, during June. There is another example in the United States National Museum, which was collected at Jarahuca, Province of Oriente, Cuba, between July 14 and 18, 1927, by S. C. Bruner. These Cuban specimens are identical with specimens of *albomaculatum* from Florida.

ELAPHIDION HISPANIOLAE, new species

Female.—Broadly elongate, moderately convex above, and similar in form to *guttiventre* Chevrolat. Above and beneath uniformly dark reddish brown, subopaque, and irregularly clothed with gray pubescence.

Head rather densely, coarsely, irregularly punctate, rather densely clothed with long, recumbent, gray pubescence, which does not entirely conceal the surface, front wider than long, nearly flat, with a narrow, longitudinal groove between the antennal tubercles, which are widely separated, and feebly elevated; eyes deeply emarginate, separated from each other on the top by about twice the width of the upper lobe. Antenna scarcely as long as the body, basal joints sparsely, irregularly punctate, sparsely, irregularly clothed with long, recumbent, gray pubescence, with a few long, erect hairs on the underside of the joints, apical joints finely, densely punctate, rather densely clothed with short, recumbent pubescence; joints 3 to 8 unispinose at apices; first joint robust, slightly clavate, subequal in length to the third joint, which is slightly longer than the

fourth, and each of the following joints equal in length to the third joint.

Pronotum feebly wider than long, and equal in width at base and apex; sides feebly rounded or subparallel; surface somewhat uneven, coarsely, irregularly, confluent punctate, sparsely, irregularly clothed with long, recumbent, gray pubescence, with a few long, erect hairs intermixed, and with an irregular, inconspicuous, elongate, glabrous spot at middle. Scutellum broadly triangular, curvilinear, and densely clothed with long, recumbent, gray pubescence.

Elytra three times as long as pronotum, and at base slightly wider than pronotum at middle; humeral angles broadly rounded; sides nearly parallel from base to apical sixth, then arcuately narrowed to the tips, which are separately, broadly subtruncate, but not spinose; surface sparsely, irregularly punctate, the punctures coarse on basal halves, but becoming obsolete toward apices, rather densely, irregularly clothed with long, recumbent, grayish pubescence, and with numerous long, erect hairs of the same color intermixed.

Abdomen beneath finely, obsoletely punctate, rather densely, irregularly clothed with long, recumbent, grayish pubescence, with numerous long, erect hairs of the same color intermixed; last visible sternite broadly sinuate at apex; last visible tergite elongate, strongly attenuate, and deeply, narrowly emarginate at apex. Prosternum sparsely, coarsely punctate, densely clothed with long, recumbent, grayish pubescence, which conceals the surface; prosternal process rather narrow, expanded behind the coxal cavities, and arcuately declivous posteriorly. Mesosternum broad, uneven between the coxal cavities, and rather abruptly declivous in front. Legs sparsely, irregularly clothed with long, recumbent and erect, grayish hairs intermixed; femora strongly expanded near middle, but not spinose at the tips.

Male.—Differing from the female in having the antennae slightly longer than the body, and the last abdominal segment broadly, arcuately rounded at apex.

Length, 12–17 mm.; width, 3.8–5.6 mm.

Type locality.—Port au Prince, Haiti.

Other localities.—L'Atalaye, Haiti; San Francisco Mountains, Dominican Republic.

Type, allotype, and paratypes.—U.S.N.M. No. 43720.

Paratypes.—In American Museum of Natural History and in Museum of Comparative Zoology.

Remarks.—Described from eight examples: The type, collected during September, 1924, by G. N. Wolcott (Acc. No. 191-24); allotype, collected at the type locality by R. J. Crew; two paratypes,

collected at L'Atalaye, Haiti, at light, February 28, 1928, and March 3, 1928, by A. J. Poole; one paratype, collected in the San Francisco Mountains, Dominican Republic, during September, 1905, by August Busck; two paratypes, received from the American Museum of Natural History, one collected at Port au Prince, Haiti, the other labeled "Santo Domingo," both collected by F. H. M. De Booy, and presented to the museum by the G. G. Heye Haitian Expedition; and one paratype received from the Museum of Comparative Zoology and labeled "Santo Domingo."

This species resembles *guttiventre* Chevrolat, but can be separated from that species in being subopaque, pronotum densely punctured, without distinct glabrous spots, and the last visible abdominal tergite elongate, strongly attenuate, and deeply, narrowly emarginate at apex.

ELAPHIDION CONFUSUM, new species

Male.—Broadly elongate, moderately convex above, and similar in form to *splendidum* Fisher. Above and beneath uniformly reddish brown, strongly shining, and irregularly clothed with white pubescence.

Head sparsely, coarsely, irregularly punctate, rather densely, irregularly clothed with moderately long, recumbent, white pubescence, front distinctly wider than long, nearly flat between the antennal tubercles, which are widely separated, but not elevated; eyes deeply emarginate, separated from each other on the top by nearly three times the width of the upper lobe. Antenna slightly longer than the body, basal joints coarsely, sparsely punctate, sparsely clothed with long, recumbent and erect, white hairs, apical joints finely, densely punctate, densely clothed with short, recumbent pubescence; joints 3 and 4 strongly unispinose at apices; joints 5 to 10 more or less bispinose; first joint robust, moderately clavate, subequal in length to the fourth joint, which is considerably shorter than the third; eleventh joint subequal in length to the tenth.

Pronotum feebly wider than long, and about equal in width at base and apex; sides strongly, arcuately rounded; disk nearly even, and ornamented with distinct, smooth, glabrous spots as follows: An elongate, median spot and a small, round spot on each side in front of middle, behind which is a narrow, longitudinal, arcuate spot (sometimes interrupted, and forming two spots); surface coarsely alveolate-punctate, and densely clothed with long, recumbent, white pubescence, which conceals the surface in well-preserved specimens.

Elytra three times as long as pronotum, and at base slightly wider than pronotum at middle; sides vaguely narrowed from base to near the tips, which are separately, broadly truncate, bispinose, with the lateral spine much longer than the sutural one; surface sparsely,

irregularly, coarsely punctate, the punctures becoming obsolete toward apices, irregularly clothed with patches of moderately long, dense, recumbent, white pubescence, with numerous long, erect hairs intermixed.

Abdomen beneath finely, rather densely, vaguely punctate, smooth and somewhat glabrous at middle, densely clothed at the sides with long, recumbent, white pubescence, with numerous long, erect hairs intermixed; last visible sternite broadly rounded at apex. Prosternum coarsely, confluent punctate, rather densely clothed with long, recumbent, white pubescence, which does not quite conceal the surface; prosternal process rather narrow, expanded behind the coxal cavities, and arcuately declivous posteriorly. Mesosternum broad, even between the coxal cavities, and rather abruptly declivous in front. Legs sparsely, irregularly clothed with long, recumbent and erect, white hairs intermixed; femora not spinose at apices, anterior and middle pairs strongly expanded near middle, posterior pair more slender.

Female.—Differs from the male in having the antennae only about as long as the body.

Length, 12–17 mm.; width, 3.6–4.4 mm.

Type locality.—Hinche, Haiti.

Other localities.—Grosmorne and Manneville, Haiti.

Type and allotype.—U.S.N.M. No. 48721.

Paratype.—In Museum of Comparative Zoology.

Remarks.—Described from three examples: The type, collected at the type locality, August 26, 1924, by G. N. Wolcott (Acc. No. 163–24); allotype, collected at Grosmorne, Haiti, February 18, 1926, by E. C. Leonard; paratype, received from the Museum of Comparative Zoology, collected at Manneville, Haiti, by William M. Mann.

This species resembles *splendidum* Fisher very closely, but it can be distinguished from that species in having the third and fourth antennal joints unispinose at the tips, the prosternum arcuately declivous posteriorly, and the elytra clothed with long, erect hairs in addition to the recumbent, white, pubescent spots.

ELAPHIDION PORTORICENSIS, new species

Male.—Narrowly elongate, feebly convex above, and similar in form to *albomaculatum* Champlain and Knull, but slightly more slender. Above and beneath uniformly bright reddish brown, strongly shining, and ornamented with white pubescent spots.

Head rather finely, longitudinally rugose, nearly glabrous, except around the eyes, where the surface is densely clothed with long, recumbent, white pubescence, front wider than long, flat between the antennal tubercles, which are widely separated, but not elevated;

eyes deeply emarginate, separated from each other on the top by nearly four times the width of the upper lobe. Antenna about as long as the body, sparsely punctate, sparsely clothed with short, recumbent pubescence, with a few long, erect hairs on the underside of the basal joints; joints 3 to 6 strongly unispinose at apices; first joint robust, strongly clavate, slightly longer than the fourth joint, which is two-thirds as long as the third; eleventh joint subequal in length to the tenth.

Pronotum distinctly longer than wide, subcylindrical, and equal in width at base and apex; disk strongly convex, even; sides nearly parallel, at most only vaguely rounded; surface coarsely, vaguely punctate, sparsely clothed along base with long, recumbent, inconspicuous hairs, and ornamented with dense, white pubescent spots as follows: A small spot in front of scutellum, a small, round spot on each side near apical margin, and a transverse, irregular spot at the lateral margins near middle. Scutellum broadly triangular, curvilinear, and densely clothed with long, recumbent, white pubescence.

Elytra nearly four times as long as pronotum, and at base distinctly wider than pronotum at middle; sides parallel from base to near the tips, which are separately, broadly truncate, bispinose, the lateral spine long and acute, but the sutural one scarcely developed; surface sparsely, coarsely, irregularly punctate, the punctures becoming obsolete toward apices, clothed with a few long, erect hairs, and each elytron ornamented with dense, white pubescent spots as follows: An elongate spot a short distance behind base, a rather broad, irregular, transverse fascia in front of middle, not extending to the sutural margin, and a broad, irregular, transverse spot at apical fourth.

Abdomen beneath feebly, sparsely punctate, very sparsely clothed with long, erect, whitish hairs, and ornamented with a dense, whitish pubescent spot at the sides of each segment, except the last visible sternite, which is broadly rounded at apex. Prosternum feebly, sparsely punctate, smooth along anterior margin, and sparsely clothed with inconspicuous, semierect hairs; prosternal process very narrow, strongly expanded behind the coxal cavities, and arcuately declivous posteriorly. Mesosternum broad, even between the coxal cavities, and rather abruptly declivous in front. Legs clothed with a few long, erect hairs; femora strongly clavate, middle and posterior pairs subspinose at the tips.

Female.—Differs from the male in having the antennae shorter than the body, and the prosternum more densely pubescent.

Length, 8–11 mm.; width, 1.8–2 mm.

Type locality.—Coamo Springs, Porto Rico.

Other locality.—Yauco, Porto Rico.

Type and allotype.—In American Museum of Natural History.

Paratypes.—U.S.N.M. No. 43722 and in Cornell University collection.

Remarks.—Described from 4 examples, 1 male and 3 females: The type (male), allotype, and 1 paratype, received from the American Museum of Natural History, all collected at the type locality, the type between June 5 and 7, 1915, the 2 other examples labeled "Coamo Springs, P. R., April 4, and April 6, 1930, Cornell Univ., Lot 795, sub. 15 and 21"; 1 paratype, collected at Yauco, Porto Rico, March 9, 1922, by G. N. Wolcott (Acc. No. 88-1922).

This species resembles *albomaculatum* Champlain and Knull, but it differs from that species in being more narrowly elongate, antennae shorter, pronotum scarcely punctured, and each elytron ornamented with three white pubescent spots.

ELAPHIDION COMPRESSIPENNE, new species

Female.—Narrowly elongate, slightly flattened above, uniformly yellowish brown, legs and antennae slightly paler, subopaque, and uniformly clothed with inconspicuous gray pubescence.

Head sparsely, irregularly punctate, somewhat rugose, sparsely, irregularly clothed with moderately long, recumbent, grayish pubescence, front distinctly wider than long, uneven, with a narrow, longitudinal groove between the antennal tubercles, which are widely separated, but not elevated; eyes deeply emarginate, separated from each other on the top by twice the width of the upper lobe. Antenna considerably shorter than the body, finely, densely punctate, rather densely clothed with recumbent, grayish pubescence, the pubescence denser on the apical joints, and with a few long, erect hairs on the underside of the basal joints; joints not spinose at apices; first joint robust, arcuate, feebly clavate, slightly longer than the third joint, which is only feebly longer than the fourth; eleventh joint subequal in length to the tenth.

Pronotum feebly wider than long, and about equal in width at base and apex; sides rather strongly, arcuately rounded; disk slightly uneven, vaguely, transversely depressed in front of middle, and without glabrous spots; surface rather densely, coarsely, irregularly punctate, and rather densely clothed with long, recumbent, inconspicuous, gray pubescence. Scutellum small, broadly triangular, curvilinear and sparsely pubescent.

Elytra four times as long as pronotum, and at base slightly wider than pronotum at middle; sides parallel from base to apical fifth, then arcuately narrowed to the tips, which are separately, broadly rounded, but not spinose; disk feebly, broadly flattened along sutural margins; surface coarsely, densely, uniformly punctate, and densely,

uniformly clothed with inconspicuous, recumbent and erect, grayish pubescence, which does not conceal the surface.

Abdomen beneath sparsely, finely punctate, sparsely clothed with long, recumbent and erect, whitish hairs; last segment broadly rounded at apex. Prosternum transversely depressed at middle and along anterior margin, coarsely punctate, more or less rugose, and sparsely clothed with long, recumbent and erect white hairs; prosternal process rather narrow, expanded behind the coxal cavities, and arcuately declivous posteriorly. Mesosternum broad, even between the coxal cavities, and abruptly declivous in front. Legs rather densely clothed with long, fine, recumbent and erect, white hairs intermixed; femora rather strongly expanded near middle, but not spinose at the tips.

Length, 14 mm.; width, 3.2 mm.

Type locality.—Mariani, Haiti.

Type.—U.S.N.M. No. 43723. A unique female collected on March 27, 1925, by W. A. Hoffman.

Remarks.—Described from the type. This species can be separated from all the other described species of this genus found in the West Indies in having the antennal joints unarmed at the tips, the elytra broadly flattened along the sutural margins, and the surface uniformly clothed with very fine, erect and recumbent pubescence intermixed.

ELAPHIDION INERME Newman

Elaphidion inerme NEWMAN, Entomologist, vol. 1, p. 29, 1840.

This species was described by Newman from North America, but among the material received from the American Museum of Natural History were five examples, which are identical with specimens of *inerme* from Florida. One of these examples was collected on Mangrove Cay, Andros Islands, during May or June, 1904, by W. M. Wheeler, two collected at the same locality, during May and June, 1917, by William M. Mann, and two other examples simply labeled "Andros Islands, Bahamas."

ELAPHIDION PILOSUM, new species

Female.—Large, broadly elongate, moderately convex above, and similar in form to *mutatum* Gahan. Above and beneath uniformly dark reddish brown, feebly shining, and irregularly clothed with grayish and yellowish pubescence.

Head coarsely, confluent punctate, rather densely clothed with long, recumbent and erect, yellowish pubescence, which does not conceal the surface, front distinctly wider than long, somewhat uneven, flat between the antennal tubercles, which are widely sepa-

rated, but scarcely elevated; eyes deeply emarginate, separated from each other on the top by about twice the width of the upper lobe. Antenna considerably shorter than the body, basal joints sparsely, coarsely punctate, sparsely, irregularly clothed with long, recumbent and erect, yellowish hairs, apical joints finely, densely punctate, densely clothed with short, recumbent pubescence; joint 3 strongly unispinose at apex; joints 4 to 8 more or less strongly bispinose; first joint robust, slightly clavate, subequal in length to the third joint, which is distinctly longer than the fourth; eleventh joint subequal in length to the tenth.

Pronotum feebly wider than long, and about equal in width at base and apex; sides nearly parallel, at most only vaguely rounded; disk uneven, ornamented with a small, round, median, glabrous spot, and two glabrous spots on each side, a small round one in front of middle, and an elongate one behind the middle, but slightly more exterior than the anterior one; surface coarsely, confluent punctate, rather densely, irregularly clothed with long, recumbent, yellowish pubescence, with a few long, erect hairs intermixed. Scutellum broadly triangular, curvilinear, and rather densely clothed with long, recumbent, grayish pubescence.

Elytra three and one-half times as long as pronotum, and at base slightly wider than pronotum at middle; sides parallel from base to apical sixth, then arcuately narrowed to the tips, which are separately, deeply emarginate, bispinose, with the lateral spine slightly longer than the sutural one; surface rather densely, coarsely, irregularly punctate, the punctures becoming sparser and finer posteriorly, sparsely, irregularly clothed with long, recumbent and erect, yellowish and grayish pubescence intermixed.

Abdomen beneath sparsely, finely punctate, densely clothed with long, recumbent and erect, whitish pubescence, which nearly conceals the surface; last segment rather narrowly rounded at apex. Prosternum sparsely, coarsely punctate, densely clothed with long, recumbent and erect, whitish pubescence, which nearly conceals the surface; prosternal process rather narrow, strongly expanded behind the coxal cavities, and arcuately declivous posteriorly. Mesosternum broad, even between the coxal cavities, and rather abruptly declivous in front. Legs sparsely, irregularly clothed with long, recumbent and erect, whitish hairs; femora rather strongly clavate, but not spinose at the tips.

Length, 20 mm.; width, 6 mm.

Type locality.—Santo Domingo, Dominican Republic.

Type.—In American Museum of Natural History. A unique female, collected by F. H. M. De Booy, presented to the American

Museum by the G. G. Heye Haitian Expedition, and labeled "Santo Domingo."

Remarks.—Described from the type.

This species is closely allied to *mutatum* Gahan, but it can be distinguished from that species in having the elytra more uniformly pubescent and without glabrous spaces.

ELAPHIDION DOZIERI, new species

Male.—Small, narrowly elongate, rather strongly flattened above, uniformly dark reddish brown; pronotum subopaque, irregularly clothed with pale yellow pubescence; elytra rather strongly shining, and irregularly clothed with white pubescence.

Head coarsely, confluent punctate, sparsely clothed with inconspicuous, semierect hairs, with a small, round spot of dense, yellowish pubescence behind each eye, front wider than long, flat between the antennal tubercles, which are widely separated, and vaguely elevated; eyes deeply emarginate, separated from each other on the top by nearly three times the width of the upper lobe. Antenna one and one-half times as long as the body, sparsely, coarsely punctate, sparsely clothed with long, recumbent and erect, yellowish hairs; joints feebly, longitudinally grooved, but not spinose at apices; first joint robust, strongly clavate, subequal in length to the fourth joint, which is considerably shorter than the third; eleventh joint subequal in length to the tenth.

Pronotum about as wide as long, and slightly narrower at base than at apex; sides strongly, arcuately rounded, nearly parallel in front of middle, strongly narrowed posteriorly; disk even, and narrowly, transversely constricted along apex, surface coarsely, deeply, confluent, ocellate-punctate, densely, irregularly clothed with long recumbent and erect, yellowish pubescence. Scutellum broadly triangular, curvilinear, and rather densely clothed with recumbent white pubescence.

Elytra nearly three times as long as pronotum, and at base about as wide as pronotum at middle; sides parallel from base to near the tips, which are separately rounded, but not spinose; surface rather densely, finely punctate, sparsely clothed with long, recumbent, white pubescence, which is denser in places, giving the surface a variegated appearance, and with numerous long, erect hairs intermixed.

Abdomen beneath rather densely, coarsely punctate, very sparsely clothed with recumbent and erect, inconspicuous hairs; last segment broadly rounded at apex. Prosternum coarsely, densely punctate, transversely rugose anteriorly, and sparsely clothed with long, semi-erect, inconspicuous hairs; prosternal process very narrow, strongly expanded behind the coxal cavities, and arcuately declivous pos-

teriorly. Mesosternum rather narrow, even between the coxal cavities, and rather abruptly declivous in front. Legs short, sparsely, irregularly clothed with long, recumbent and erect, whitish hairs intermixed; femora strongly clavate, but not spinose at apices.

Female.—Differs from the male in having the antennae about as long as the body, and the pronotum slightly more rounded at the sides.

Length, 6.6–8 mm.; width, 1.8–2 mm.

Type locality.—Port au Prince, Haiti.

Other locality.—Manneville, Haiti.

Type.—U.S.N.M. No. 43724. Male, collected March 28, 1930, by H. L. Dozier.

Allotype.—In American Museum of Natural History. Collected at Manneville, between February 6 and 10, 1922.

Remarks.—Described from the type and allotype.

This species resembles a small, short specimen of *villosum* Fabricius, but it differs from that species in having the joints of the antennae feebly, longitudinally grooved, but unarmed at the apices, elytra broadly rounded at the tips, the surface variegated with white pubescence, and the femora short and strongly clavate.

ELAPHIDION COSTIPENNE, new species

Female.—Small, narrowly elongate, slightly flattened above, brownish black, rather strongly shining, legs and antennae slightly more reddish, the elytra subcostate, and irregularly clothed with grayish pubescence.

Head coarsely, irregularly punctate, longitudinally rugose, sparsely clothed with long, recumbent, grayish pubescence, with a few long, erect hairs intermixed, front wider than long, flat between the antennal tubercles, which are widely separated, and vaguely elevated; eyes deeply emarginate, separated from each other on the top by nearly three times the width of the upper lobe. Antenna not quite so long as the body, basal joints sparsely, coarsely punctate, sparsely clothed with long, recumbent and erect, grayish hairs, apical joints finely, densely punctate, rather densely clothed with short, recumbent pubescence; joints 3 to 7 more or less unispinose at apices; first joint robust, rather strongly clavate, subequal in length to the third joint, which is twice as long as the fourth; eleventh joint flattened and subequal in length to the tenth.

Pronotum vaguely wider than long, and about equal in width at base and apex; sides strongly, arcuately rounded, rather strongly constricted at base and anterior margin; disk even, ornamented with a broad, glabrous median vitta, extending from base to anterior margin, and with a number of small, irregular, inconspicuous, glab-

rous spots on each side; surface coarsely irregularly punctate, and rather densely, irregularly clothed with long, recumbent, yellowish-white pubescence, with a few long, erect hairs intermixed. Scutellum broadly triangular, curvilinear, and rather densely clothed at the sides with long, recumbent, grayish pubescence.

Elytra three and one-half times as long as pronotum, and at base slightly wider than pronotum at middle; sides parallel from base to near the tips, which are separately, deeply emarginate, bispinose, with the lateral spine slightly longer than the sutural one; disk feebly, broadly flattened along the sutural margins; surface coarsely, rather sparsely, irregularly punctate, the punctures more obsolete near apices, sparsely, irregularly clothed with long recumbent, grayish pubescence, and with a more or less distinct glabrous space on each elytron behind the middle.

Abdomen beneath sparsely, vaguely punctate, clothed with long, recumbent and erect, whitish pubescence, the pubescence dense at the sides, sparse on the median parts; last segment broadly rounded at apex. Prosternum coarsely, sparsely punctate, and rather densely clothed with long, recumbent and erect, whitish pubescence; prosternal process rather narrow, sides nearly parallel, broadly rounded at apex, and abruptly declivous posteriorly. Mesosternum broad, even between the coxal cavities, and abruptly declivous in front. Legs sparsely clothed with recumbent, grayish pubescence, with a few long, erect hairs intermixed; femora rather strongly clavate, posterior pair armed with two obtuse spines at apices, anterior and middle pairs unarmed.

Length, 9 mm.; width, 2.4 mm.

Type locality.—Fond Parisien, Haiti, which is on the south shore of Lake Assuei, about 10 miles on a straight line (across the lake) southeast of Manneville. This region would be arid except for irrigation, and has an altitude of 60 feet.

Type.—In American Museum of Natural History. A unique female collected at light between February 11 and 18, 1922, by F. E. Watson.

Remarks.—Described from the type.

This species resembles a small example of *insulare* Newman, but it differs from that species in having the elytra somewhat costate, causing the surface to be broadly flattened along the sutural margins.

ELAPHIDION JAMAICENSIS, new species

Female.—Broadly elongate, feebly convex above, and similar in form to *muconatum* Say. Above and beneath dark reddish brown, legs slightly paler, rather strongly shining, elytra slightly costate, and the grayish pubescence arranged in more or less distinct vittae.

Head sparsely, coarsely, irregularly punctate, with a few fine punctures intermixed, rather densely, irregularly clothed with long, recumbent, yellowish-white pubescence, front wider than long, transversely grooved behind the epistoma, longitudinally grooved and broadly concave between the antennal tubercles, which are widely separated and slightly elevated; eyes deeply emarginate, separated from each other on the top by three times the width of the upper lobe. Antenna as long as the body, basal joints sparsely, coarsely punctate, more or less rugose, sparsely, irregularly clothed with long, recumbent, yellowish pubescence, with a few long, erect hairs on the underside of the joints, apical joints finely, densely punctate, densely clothed with short, recumbent pubescence; joints 3 to 6 strongly unispinose at apices; first joint robust, strongly clavate, and subequal in length to the third and fourth joints united; third joint nearly twice as long as the fourth; eleventh joint subequal in length to the tenth.

Pronotum slightly wider than long, and equal in width at base and apex; sides strongly sinuate, subtuberculate; disk uneven, and ornamented with an acute tubercle on each side at apical third, a longitudinal, median, glabrous spot, irregularly expanded at middle, extending from anterior margin to base, and a rather large, rounded, glabrous spot on each side at apical third; surface rather densely, coarsely, irregularly punctate, sparsely, irregularly clothed with long, recumbent, yellowish-white pubescence. Scutellum broadly triangular, curvilinear, median part glabrous, sides densely clothed with recumbent, yellowish pubescence.

Elytra three times as long as pronotum, and at base slightly wider than pronotum at middle; sides parallel from base to apical sixth, then arcuately narrowed to the tips, which are separately, deeply emarginate, bispinose, with the lateral spine much longer than the sutural one; surface rather densely, coarsely, irregularly punctate; each elytron with three broad, more or less distinct, longitudinal costae, and clothed between the costae with rows of sparse, recumbent, gray pubescence.

Abdomen beneath finely, sparsely, irregularly punctate, sparsely, irregularly clothed with long, recumbent and erect, grayish pubescence, the pubescence sparser on median part; last segment broadly rounded at apex. Prosternum coarsely punctate, sparsely clothed with long, recumbent, grayish hairs at the sides, nearly glabrous and impunctate at middle and along anterior margin; prosternal process rather wide, flat, expanded behind the coxal cavities, then attenuate to the tip, which is acute, but not declivous. Mesoternum deeply, triangularly emarginate, and concave in front for the insertion of the prosternal process. Legs sparsely, irregularly clothed with long,

recumbent and semierect, grayish hairs intermixed; femora moderately clavate, the middle pair armed with an obtuse spine on inner side at apices, posterior pair with two obtuse spines at apices, the inner spine longer than the outer one.

Length, 14-15 mm.; width, 4-4.4 mm.

Type locality.—Mandeville, Manchester, Jamaica.

Other locality.—Trelawney, Jamaica.

Type.—In American Museum of Natural History.

Paratype.—U.S.N.M. No. 43725.

Remarks.—Described from two females (one type) received from the American Museum of Natural History. The type collected at light, December 20, 1919, by F. E. Watson, and the paratype collected at Trelawney, Jamaica, March 17, 1931, by E. L. Bell (Acc. 31224).

This species does not entirely agree with the other species of this genus, and differs from the other described West Indian species in having the prosternal process acutely rounded at the apex, and not declivous, and the mesosternum deeply, triangularly emarginate in front for the insertion of the prosternal process.

ELAPHIDION ANTILLARUM, new species

Female.—Narrowly elongate, subcylindrical, strongly convex above. Above and beneath uniformly dark reddish brown, strongly shining, antennae slightly paler, and the elytra irregularly ornamented with white pubescent spots.

Head coarsely, confluent punctate, sparsely clothed with recumbent, whitish hairs, with a small spot of dense, whitish pubescence behind each antennal tubercle, front slightly wider than long, flat between the antennal tubercles, which are widely separated, and feebly elevated; eyes deeply emarginate, and separated from each other on the top by three times the width of the upper lobe. Antenna not quite so long as the body, rather coarsely sparsely punctate, sparsely clothed with long, recumbent and erect, whitish hairs intermixed, surface more finely punctate and more densely pubescent on apical joints; joints vaguely spinose; first joint robust, moderately clavate, subequal in length to the third joint, which is slightly longer than the fourth; eleventh joint subequal in length to the tenth.

Pronotum vaguely wider than long, and subequal in width at base and apex; sides strongly, arcuately rounded; disk even, moderately convex; surface densely alveolate-punctate, the cells deep and elongate, a short, recumbent, whitish hair arising from each puncture, and clothed with a few long, erect hairs. Scutellum broadly triangular, curvilinear, and rather densely clothed with recumbent, whitish pubescence.

Elytra two and one-half times as long as pronotum, and at base feebly wider than pronotum at middle; sides feebly narrowed from base to near the tips, which are separately, feebly, broadly emarginate, but not spinose; surface rather densely, coarsely, irregularly punctate, very sparsely clothed with short, recumbent, whitish hairs, with a few very long, erect, whitish hairs intermixed, and each elytron ornamented with an irregular spot of moderately dense, white pubescence at middle, and a similar spot near apex.

Abdomen beneath sparsely, finely, irregularly punctate, vaguely granulose, and sparsely clothed with long, fine, semierect hairs; last segment broadly rounded at apex. Prosternum sparsely, coarsely punctate, feebly, transversely rugose anteriorly, and sparsely clothed with recumbent, whitish pubescence; prosternal process very narrow, feebly expanded behind the coxal cavities, and arcuately declivous posteriorly. Mesosternum rather narrow between the coxal cavities, and feebly declivous in front. Legs rather long, sparsely, irregularly clothed with long, recumbent and erect, whitish hairs; femora strongly clavate, but not spinose at apices.

Length, 6.4 mm.; width, 1.6 mm.

Type locality.—Source Matelas, Haiti.

Type and paratype.—U.S.N.M. No. 43726.

Remarks.—Described from two females (one type) collected at Source Matelas, Haiti, at edge of the sea on "mangle" or mangrove, March 24, 1930, by H. L. Dozier.

The paratype (broken) is larger than the type, 8.2 mm. long and 2.2 mm. wide. This specimen differs slightly from the type in having the pronotum ornamented with a few irregular spots of whitish pubescence, and the white pubescent spots of the elytra more distinct than on the type.

This species resembles *dozieri* Fisher, but differs from that species in being more slender, the pronotum more strongly rounded at the sides, and the surface with elongate, alveolate punctures, elytra with more or less distinct pubescent spots (not variegated as in *dozieri*), with the tips emarginate, and the legs longer.

ELAPHIDION GRACILIS, new species

Male.—Narrowly elongate, subcylindrical, slightly flattened above. Above and beneath uniformly reddish brown, feebly shining, and rather densely, irregularly clothed with pale yellow and whitish pubescence intermixed.

Head coarsely, confluent punctate, densely clothed with long, recumbent, whitish pubescence (yellowish on the occiput), which nearly conceals the surface, front wider than long, flat between the

antennal tubercles, which are widely separated, and vaguely elevated; eyes deeply emarginate, and separated from each other on the top by three times the width of the upper lobe. Antenna one and one-half times as long as the body, coarsely, sparsely punctate, sparsely clothed with long, recumbent and erect, whitish hairs intermixed, apical joints finely punctate, and densely clothed with short, recumbent pubescence; joints unarmed at apices; first joint robust, slightly arcuate, moderately clavate, one-half as long as the third joint, which is considerably longer than the fourth; eleventh joint slightly longer than the tenth.

Pronotum slightly longer than wide, and feebly narrower at base than at apex; sides subparallel (vaguely rounded at middle); disk even, and slightly flattened; surface densely, coarsely punctate, densely clothed with long, recumbent, whitish and pale yellow pubescence, with a few long, erect hairs intermixed, the pubescence nearly concealing the surface. Scutellum broadly triangular, curvilinear, and rather densely clothed with recumbent, whitish pubescence.

Elytra three times as long as the pronotum, and at base distinctly wider than pronotum at middle; sides parallel from base to near the tips, which are conjointly, broadly rounded, but not spinose; surface rather densely, coarsely, irregularly punctate, densely clothed with long, recumbent, whitish and pale yellow pubescence, which partially conceals the surface, the whitish pubescence predominating, and with a few long, erect, white hairs intermixed.

Abdomen beneath coarsely, sparsely punctate, rather densely clothed with long, recumbent and semierect, whitish pubescence; last segment broadly rounded at apex. Prosternum rather densely, finely punctate, transversely rugose anteriorly, densely clothed with long, recumbent, whitish pubescence; prosternal process very narrow, and arcuately declivous posteriorly. Mesosternum rather narrow, even between the coxal cavities, and scarcely declivous in front. Legs rather long, sparsely, irregularly clothed with long, recumbent and erect, whitish hairs; femora strongly clavate, but not spinose at apices.

Female.—Differs from the male in having the antenna about as long as the body, eleventh joint subequal in length to the tenth, pronotum as wide as long, yellow pubescence not distinct on dorsal surface, and the femora not so strongly clavate.

Length, 7–8 mm.; width 1.8–2 mm.

Type locality.—Camaguey, Cuba.

Other locality.—Cayamas, Cuba.

Type, allotype, and paratype.—U.S.N.M. No. 43727.

Paratype.—In American Museum of Natural History.

Remarks.—Described from 4 examples, 3 males and 1 female: The type, allotype, and one paratype, collected at the type locality during July, 1923, by J. Acuña; and one paratype collected at Cayamas, Cuba, May 11, by E. A. Schwarz.

This species resembles *dozieri* Fisher very closely, but it differs from that species in being more slender, the pronotum distinctly narrower than the elytra, and the surface more sparsely punctured, elytra with the sides more parallel and the surface more densely pubescent (not variegated as in *dozieri*), and the legs longer.

ELAPHIDION NEWMANI Haldeman

Elaphidion bidens NEWMAN (not Fabricius), Entomologist, vol. 1, p. 25, 1840.

Elaphidion newmanii HALDEMAN, Proc. Amer. Philos. Soc., vol. 4, p. 375, 1847.

Newman (1840) recorded *Elaphidion bidens* Fabricius from Brazil, but this is not the species described by Fabricius under that name, so Haldeman (1847) gave *bidens* Newman (not Fabricius) the new name *newmanii* (*njumanii* by typographical error). The species described by Fabricius from South America under *bidens* has the joints of the antennae bispinose, whereas the species described by Newman under the same name has the joints unispinose.

This is a South American species and should be dropped from the West Indian lists.

PROTOSPHAERION TESTACEUM, new species

Rather narrowly elongate, feebly flattened above, strongly shining, yellowish brown, and the legs slightly paler.

Head coarsely, confluent punctate, the punctures deep, elongate, and a short, inconspicuous hair arising from each puncture, front wider than long, flat between the antennal tubercles, which are widely separated, but scarcely elevated; eyes deeply emarginate, separated from each other on the top by three times the width of the upper lobe. Antenna slightly longer than the body, rather finely, sparsely punctate, sparsely clothed with short, recumbent, yellowish hairs, with a few long, erect hairs on the underside of the joints; joints more or less flattened, vaguely, longitudinally grooved, and joints 3 to 7 more or less unispinose at apices; first joint robust, moderately clavate, slightly longer than the fourth joint, which is one-half as long as the third; eleventh joint subequal in length to the tenth.

Pronotum slightly longer than wide, and subequal in width at base and apex; sides feebly constricted near base and apex, rather strongly, arcuately rounded at middle; disk slightly convex, even; surface coarsely, irregularly punctate, the punctures dense at the sides, but becoming more irregular and distant toward the middle,

and clothed with a few long, erect, inconspicuous hairs. Scutellum broad, broadly rounded at apex, and clothed with long, inconspicuous hairs.

Elytra nearly three times as long as pronotum, and at base vaguely wider than pronotum at middle; sides nearly parallel from base to near the tips, which are narrowly, transversely truncate; surface densely, coarsely, uniformly punctate, the punctures becoming smaller and more distant toward the apices, and a long, fine, erect hair arising from some of the punctures.

Abdomen beneath vaguely punctured and very sparsely clothed with a few inconspicuous, erect hairs; last segment broadly rounded at apex. Prosternum sparsely, coarsely, irregularly punctate, and clothed with a few inconspicuous hairs; prosternal process narrow between the coxal cavities. Legs rather short, sparsely, irregularly clothed with long, semierect hairs; femora strongly clavate, unarmed at apices; tibiae not carinate.

Length, 10 mm.; width, 2.6 mm.

Type locality.—Manneville, Haiti.

Type.—In American Museum of Natural History. A unique specimen (sex not determined) received from the American Museum of Natural History, collected February 18, 1922.

Remarks.—Described from the type.

This species resembles *Protosphaerion insulare* White, described from Jamaica, but differs from that species in having the pronotum more sparsely and irregularly punctured, antennae flattened, and the joints vaguely, longitudinally grooved, and the tips of the elytra narrowly, transversely truncate.

STIZOCERA VANZWALUWENBURGI, new species

Male.—Narrowly elongate, subcylindrical, feebly flattened above, and strongly shining; above pale yellow, head slightly darker, and humeri black; beneath brownish yellow, with the median part of the prosternum black.

Head sparsely, vaguely punctate, and nearly glabrous, front wider than long, broadly, transversely depressed behind the epistoma, the depression deeper on each side, narrowly, longitudinally grooved between the antennal tubercles, which are widely separated, but not elevated; eyes deeply emarginate, and separated from each other on the top by three times the width of the upper lobe. Antenna nearly twice as long as the body, finely, sparsely punctate, sparsely clothed with short and long, semierect, yellowish hairs, joints cylindrical, not longitudinally grooved, and joints 3 to 8 strongly unispinose at apices; first joint robust, slightly arcuate, feebly clavate, considerably

shorter than the third joint, which is slightly longer than the fourth; eleventh joint slightly longer than the tenth.

Pronotum slightly wider than long, and subequal in width at base and apex; sides feebly constricted near base and apex, with an obtuse tubercle on each side at middle; disk uneven, with a round, feebly elevated tubercle at middle, and two similar tubercles arranged longitudinally on each side; surface nearly impunctate, with a few long, inconspicuous, erect hairs. Scutellum triangular, curvilinear, and densely clothed with short, recumbent, white pubescence.

Elytra four times as long as pronotum, and at base slightly wider than pronotum at middle; humeral angles broadly rounded; sides nearly parallel from base to near the tips, which are separately, broadly emarginate, strongly bispinose, with the lateral spine much longer than the sutural one; surface sparsely, finely, irregularly punctate, with a few coarser punctures intermixed, and clothed with a few long, rather stiff, erect, yellowish hairs.

Abdomen beneath sparsely, irregularly punctate, clothed with a few inconspicuous, semierect hairs; last segment broadly subtruncate at apex. Prosternum transversely, arcuately elevated anteriorly, median part sparsely, coarsely punctate, and sparsely clothed with whitish pubescence, sides and anterior third smooth and glabrous; prosternal process very narrow between the coxal cavities, and arcuately declivous posteriorly. Legs rather long, sparsely clothed with long, semierect, yellowish hairs. Femora rather strongly clavate; posterior pair obtusely bispinose at apices. Tibiae longitudinally carinate.

Female.—Differs from the male in having the antennae about one and one-fourth times as long as the body, and the median part of the prosternum only feebly punctured.

Length, 11.5–19 mm.; width, 2.8–4 mm.

Type locality.—Mayaguez, Porto Rico.

Other localities.—San German and Coamo Springs, Porto Rico.

Type and allotype.—In American Museum of Natural History.

Paratypes.—U.S.N.M. No. 43728 and in Cornell University collection.

Remarks.—Described from 5 examples, 3 males and 2 females, received from the American Museum of Natural History: The type, collected at light October 15, 1916, by R. H. Van Zwaluwenburg; allotype, collected at the type locality, December, 1930, by Dr. S. T. Danforth; one paratype, collected at Coamo Springs, Porto Rico, August 4, 1930, labeled "Cornell Univ. Lot 795, Sub. 15," and two paratypes, collected at San German, April 16, 1930, labeled "Cornell Univ. Lot 795, Sub. 34."

This species is allied to *insulana* Gahan, described from Jamaica, but it differs from that species in having the pronotum nearly impunctate, the femora obtusely bispinose at apices, and the tibiae longitudinally carinate.

This species is named in honor of R. H. Van Zwaluwenburg, who has very greatly increased our knowledge of the fauna of Porto Rico by his careful and energetic collecting and has carefully studied some of the difficult genera of the family Elateridae.

HETERACHTES FULGENS, new species

Narrowly elongate, subcylindrical, feebly flattened above, and strongly shining; elytra whitish yellow, and each elytron narrowly margined dark brown, prothorax slightly darker; antennae, legs, and underside of body (except the prosternum) reddish.

Head very sparsely, irregularly punctate, vaguely rugose, glabrous, front short, strongly transverse, narrowly, deeply, transversely grooved behind the epistoma, the groove extending on each side along the inner margin of the eyes to near the antennal cavities, a narrow, longitudinal, median groove extending from epistoma to vertex, surface strongly, broadly concave between the antennal tubercles, which are rather strongly elevated; eyes deeply emarginate, and separated from each other on the top by four times the width of the upper lobe. Antenna twice as long as the body, sparsely punctate, sparsely clothed with short, whitish pubescence, with numerous long, erect hairs on underside of joints, which are unarmed at apices; basal joints flattened, and longitudinally carinate; first joint robust, moderately clavate, considerably shorter than the third joint, which is slightly longer than the fourth; eleventh joint slightly longer than the tenth.

Pronotum considerably longer than wide, and subequal in width at base and apex; sides parallel, sinuate, and feebly constricted near base and apex; disk vaguely uneven, broadly, feebly, transversely concave anteriorly, deeply transversely depressed near base; surface smooth and glabrous, except narrowly along the base, where it is finely, densely punctate, and sparsely clothed with fine, short, pubescence. Scutellum elongate, curvilinear, and densely clothed with recumbent, white pubescence.

Elytra two and one-half times as long as pronotum, and at base distinctly wider than pronotum at middle; humeri strongly elevated; sides nearly parallel from base to near the tips, which are separately, transversely truncate, with a moderately long, obtuse spine at lateral margin; surface smooth and glabrous, except for two longitudinal rows of very widely separated punctures on each elytron, and a long, stiff, erect, yellowish hair arising from each puncture.

Abdomen beneath feebly, sparsely punctate, vaguely granulose, sparsely clothed with short, recumbent, whitish pubescence, with a few long, erect hairs intermixed; last segment broadly subtruncate at apex. Prosternum transversely flattened on apical half, median part feebly, finely punctate, and sparsely clothed with short, inconspicuous pubescence, sides and anterior half impunctate and glabrous, the anterior part vaguely, transversely rugose; prosternal process very narrow between the coxal cavities, strongly expanded and arcuately declivous posteriorly. Legs long; femora strongly clavate, unarmed at apices; tibiae longitudinally carinate.

Length, 11.5 mm.; width, 2.8 mm.

Type locality.—Dominica, Leeward Islands, West Indies.

Type.—U.S.N.M. No. 43729. Collected by H. A. Ballou.

Remarks.—Described from a single example (sex not determined).

This species can be easily separated from the other described species of this genus found in the West Indies by its pale yellow color, and in having the upper surface strongly shining and nearly glabrous.

CYLINDERA FASCIATA, new species

Female.—Rather broadly elongate, moderately flattened above, strongly shining, uniformly dark reddish brown, tibiae and antennae slightly paler, and each elytron ornamented with a transverse, oblique, yellow fascia in front of middle, composed of two elongate spots connected to each other, the sutural spot slightly behind the lateral one.

Head coarsely, irregularly punctate, coarsely rugose, and clothed with a few long, erect, white hairs, front strongly transverse, with a short, longitudinal, median groove between the antennal tubercles, which are widely separated, and scarcely elevated, surface broadly, transversely concave on vertex; eyes oblong, strongly convex, and feebly emarginate. Antenna about as long as the body, sparsely clothed with short, recumbent pubescence, with numerous long hairs on the underside of the joints, which are slightly flattened, but unarmed at apices; first joint robust, cylindrical, vaguely longer than the third joint, which is subequal in length to the fourth; eleventh joint subequal in length to the tenth.

Pronotum slightly wider than long, and subequal in width at base and apex; sides strongly, arcuately rounded, slightly constricted at base, with an inconspicuous, obtuse tubercle, on each side at middle; disk strongly, regularly convex; surface very sparsely, coarsely, irregularly punctate, and clothed with a few long, erect, rather stiff, white hairs. Scutellum transverse, broadly rounded at apex, and glabrous.

Elytra three times as long as the pronotum, and at base distinctly wider than pronotum at middle; humeri rather strongly elevated; sides nearly parallel from base to apical fourth, then feebly, arcuately narrowed to the tips, which are separately, broadly, transversely truncate, and vaguely emarginate; surface slightly flattened along sutural margins behind middle, coarsely, rather densely, irregularly punctate, the punctures becoming sparser toward apices, and sparsely clothed with long, erect, stiff, white hairs.

Abdomen beneath very sparsely punctate, and a long, erect white hair arising from each puncture; last segment broadly rounded at apex. Prosternum strongly convex, narrowly, transversely depressed along anterior margin, very sparsely punctate, vaguely, transversely rugose, and clothed with a few long, erect white hairs; prosternal process narrow between the coxal cavities, strongly expanded and arcuately declivous posteriorly. Legs rather long, sparsely clothed with long, semierect, white hairs; femora strongly, abruptly clavate, petiolate at bases, not spinose at apices; tibiae not longitudinally carinate.

Length, 10 mm.; width, 3.6 mm.

Type locality.—Guantanamo, Cuba.

Type.—U.S.N.M. No. 43730. A unique female collected at light on the San Carlos Estate, June 10, 1915, by C. T. Ramsden.

Remarks.—Described from the type.

This species can be separated from *flava* Fabricius in having the upper surface dark reddish brown, and each elytron ornamented with a transversely oblique, yellow fascia.

CYLINDERA PUNCTICOLLIS, new species

Female.—Small, rather narrowly elongate, slightly flattened above, uniformly dark reddish brown, antennae and legs vaguely paler; head and pronotum subopaque; elytra strongly shining, with a vague, aeneous reflection in certain lights.

Head coarsely alveolate-punctate, and clothed with a few long, erect hairs, front strongly transverse, slightly concave between the antennal tubercles which are widely separated, and acutely elevated; surface broadly, transversely concave on vertex; eyes oblong, strongly convex, and feebly emarginate. Antenna broken, sparsely pubescent, with a few long, erect hairs on the underside of the joints, which are cylindrical, slightly expanded but unarmed at apices; first joint robust, cylindrical, slightly longer than the third joint, which is vaguely longer than the fourth.

Pronotum slightly wider than long, and subequal in width at base and apex; sides strongly, arcuately rounded, rather strongly constricted at base and apex; disk rather strongly, regularly convex;

surface coarsely alveolate-punctate, the cells elongate and irregular in shape, a narrow, elongate, smooth, median space behind middle, but not extending to base, and clothed with a few long, inconspicuous, erect hairs. Scutellum oval, and glabrous.

Elytra three times as long as pronotum, and at base slightly wider than pronotum at middle; humeri strongly elevated; sides nearly parallel from base to apical fifth, then arcuately narrowed to the tips, which are separately, narrowly rounded; disk feebly flattened; surface densely, coarsely, irregularly punctate on basal halves, the punctures becoming finer and sparser toward apices, and very sparsely clothed with long, erect, stiff, yellowish hairs.

Abdomen beneath vaguely punctate, and clothed with a few long, erect, inconspicuous hairs; last segment broadly rounded at apex. Prosternum strongly convex, narrowly, transversely depressed along anterior margin, coarsely, vaguely punctate, and without distinct pubescence; prosternal process very narrow between the coxal cavities, strongly expanded and arcuately declivous posteriorly. Legs rather long, and sparsely clothed with long, recumbent and erect, yellowish hairs; femora strongly, abruptly clavate, petiolate at bases, unarmed at apices; tibiae longitudinally carinate.

Length, 7 mm.; width, 2.2 mm.

Type locality.—Port au Prince, Haiti.

Type.—U.S.N.M. No. 43731. Female collected January 20, 1925, by G. N. Wolcott.

Remarks.—Described from the type.

This species can be separated from the other described species of this genus found in the West Indies in having the pronotum coarsely alveolate-punctate.

CYLINDERA GLABRA, new species

Small, elongate, strongly flattened above, and subopaque; head, pronotum, and underside of body reddish brown; elytra and legs yellowish brown, except the bases of the tibiae, which are darker.

Head coarsely, confluent punctate, and glabrous, front strongly transverse, deeply, narrowly, transversely grooved behind the epistoma, the groove not extending to the eyes, strongly, transversely, arcuately elevated between the antennal tubercles, which are widely separated, but not elevated; eyes small, oblong, strongly convex, but not emarginate. Antenna as long as the body, sparsely clothed with short, recumbent pubescence, with a few long, erect hairs on the underside of the joints, which are cylindrical, and unarmed at apices; first joint robust, cylindrical, subequal in length to the fourth joint, which is twice as long as the third; eleventh joint slightly longer than the tenth.

Pronotum as wide as long, and subequal in width at base and apex; sides feebly, arcuately rounded at middle, more strongly rounded toward apex, and strongly, narrowly constricted at base; anterior margin broadly, arcuately rounded; disk rather strongly flattened; surface glabrous, finely, longitudinally rugose, the rugae narrow, strongly elevated, more or less irregular, and close together. Scutellum narrowly transverse, emarginate at apex, and glabrous.

Elytra three times as long as pronotum, and at base subequal in width to the pronotum at middle; humeri rather strongly elevated; sides nearly parallel from base to apical fifth, then arcuately narrowed to the tips, which are separately, narrowly rounded; disk feebly flattened; surface glabrous, coarsely, densely, uniformly punctate.

Abdomen beneath glabrous, rather densely, coarsely, but not deeply, punctate; last segment broadly rounded at apex. Prosternum strongly convex, nearly glabrous, rather densely, coarsely, but not deeply, punctate; prosternal process very narrow between the coxal cavities, and arcuately declivous posteriorly. Legs rather short, sparsely clothed with short, recumbent, inconspicuous pubescence; femora gradually, strongly clavate, petiolate at bases, unarmed at apices; tibiae robust, expanded toward apices, but not longitudinally carinate.

Length, 4.75 mm.; width, 1.4 mm.

Type locality.—Cayamas, Cuba.

Type.—U.S.N.M. No. 43732. A unique example (sex not determined), collected January 19, by E. A. Schwarz.

Remarks.—Described from the type.

This little species differs from all the other described species of this genus found in the West Indies in having the upper surface glabrous, and the pronotum finely, densely, longitudinally rugose. It does not quite agree generically with *flava* Fabricius, the type of the genus, but it is placed temporarily in this genus until more material is available for study.

MEROSTENUS ASPERATUS, new species

Male.—Narrow, elongate, subcylindrical, and similar in form to *attenuatus* Chevrolat. Above and beneath opaque, uniformly pale reddish brown, the antennae and legs feebly paler.

Head densely, minutely alutaceous, glabrous, front wider than long, rather deeply, narrowly depressed behind the epistoma and along inner margin of eyes, with a vague, narrow, longitudinal, median groove, feebly, broadly concave between the antennal tubercles, which are slightly elevated; surface broadly, transversely concave on vertex; eyes large, strongly convex, moderately emarginate, and widely

separated from each other at the top. Antenna one and one-half times as long as the body, joints feebly flattened, unarmed at apices, and sparsely clothed with short, inconspicuous, recumbent pubescence; first joint robust, feebly arcuate, slightly clavate, subequal in length to the fourth joint, which is slightly longer than the third; eleventh joint slightly longer than the tenth.

Pronotum distinctly longer than wide, and subequal in width at base and apex; sides obliquely diverging from apex to basal fourth, where they are arcuately expanded, then strongly, narrowly constricted at base; disk even, narrowly, but not deeply, transversely depressed along base; surface glabrous, densely minutely alutaceous. Scutellum small, oval, and glabrous.

Elytra slightly more than twice as long as pronotum, and at base feebly wider than pronotum at basal fourth; humeri moderately elevated; sides nearly parallel from base to near the tips, which are separately, broadly rounded; surface glabrous, finely, densely granulate, and uniformly, sparsely covered with small, inconspicuous asperities.

Abdomen beneath sparsely, feebly, punctate, and sparsely clothed with short, semierect, inconspicuous hairs; last segment broadly rounded and feebly emarginate at apex. Prosternum glabrous, finely alutaceous posteriorly, feebly, transversely rugose anteriorly; prosternal process very narrow between the coxal cavities, and arcuately declivous posteriorly. Legs rather long, sparsely clothed with short, recumbent, inconspicuous pubescence; femora strongly, abruptly clavate, slightly flattened, petiolate at bases, unarmed at apices; tibiae slightly flattened, the anterior pair feebly arcuate.

Length, 4.6–6.6 mm.; width, 1–1.6 mm.

Type locality.—Manneville, Haiti.

Other locality.—Fond Parisien, Haiti.

Type and paratype.—In American Museum of Natural History.

Paratype.—U.S.N.M. No. 43733.

Remarks.—Described from three examples received from the American Museum of Natural History, all collected at light by F. E. Watson: The type, collected February 18, 1922; and two paratypes, collected at Fond Parisien, Haiti, between February 11 and 18, 1922. Sexes not determined.

This species is closely allied to *attenuatus* Chevrolat, described from Cuba, but it differs from that species in having the elytra opaque, densely granulate, and covered with small asperites.

MEROSTENUS SIMILIS, new species

Female.—Similar to *asperatus* Fisher, but differs from that species as follows: Front of head flat between the antennal tubercles, which

are not elevated, antennae about as long as the body, and the joints cylindrical, pronotum shorter, the surface more finely alutaceous, and not transversely depressed along the base, elytra three times as long as the pronotum, and the surface coarsely, densely, and uniformly punctate, except the extreme tips.

Length, 6.2–6.8 mm; width, 1.2–1.4 mm.

Type locality.—Antigua, West Indies.

Type.—U.S.N.M. No. 43734. Collected in June.

Paratype.—In American Museum of Natural History. Labeled "Antigua, October 24, 1911," and donated to that museum by C. W. Leng.

Remarks.—Described from the type and paratype.

MEROSTENUS ELONGATUS, new species

Female.—Narrow, subcylindrical, and slightly more slender than *attenuatus* Chevrolat. Above and beneath feebly shining, yellowish brown, with the prosternum and underside of abdomen slightly darker.

Head densely, coarsely punctate, rather densely clothed with short, recumbent, yellowish pubescence, front rather strongly constricted by the eyes, deeply, narrowly, transversely depressed behind the epistoma, with a vague, narrow, median, longitudinal groove, and feebly, broadly depressed on vertex, broadly concave between the antennal tubercles, which are slightly elevated; eyes large, strongly convex, moderately emarginate, and widely separated from each other on the top. Antenna about as long as the body, joints cylindrical, unarmed at apices, and sparsely clothed with short, recumbent pubescence; first joint robust, feebly arcuate, slightly clavate, subequal in length to the fourth joint, which is slightly longer than the third; eleventh joint subequal in length to the tenth.

Pronotum distinctly longer than wide, and subequal in width at base and apex; sides feebly, obliquely diverging from apex to basal fourth, where they are broadly, arcuately expanded, then feebly, narrowly constricted at base; disk slightly uneven, with five vague callosities, one median, and two arranged longitudinally on each side; surface densely, finely punctate, and rather densely clothed with short, recumbent, inconspicuous pubescence. Scutellum small, elongate, and densely clothed with recumbent pubescence.

Elytra nearly four times as long as pronotum, and at base slightly wider than pronotum at basal fourth; humeri moderately elevated; sides nearly parallel from base to apical sixth, then strongly narrowed to the tips, which are separately, acutely rounded; surface densely, coarsely, irregularly punctate, and sparsely clothed with short, recumbent, inconspicuous pubescence.

Abdomen beneath feebly punctate and sparsely clothed with short, recumbent pubescence; last segment broadly truncate at apex. Prosternum densely, coarsely punctate posteriorly, more sparsely punctate anteriorly, and sparsely clothed with short, inconspicuous hairs; prosternal process very narrow between coxal cavities, and strongly declivous posteriorly. Legs rather long, sparsely clothed with short, inconspicuous hairs; femora moderately clavate, unarmed at apices, posterior pair longer, slightly clavate, and feebly arcuate; tibiae slender, cylindrical, anterior pair feebly enlarged toward apices.

Length, 7 mm; width, 1.2 mm.

Type locality.—Wajay, Habana, Cuba.

Type.—U.S.N.M. No. 43735. A single female collected December 15, 1930, by S. C. Bruner.

Remarks.—Described from the type.

This species differs from all the other described species of this genus found in the West Indies in being more slender and in having the upper surface densely, coarsely punctured, and clothed with short, recumbent pubescence.

PENTOMACRUS PUNCTATUS, new species

Male.—Broadly elongate, rather strongly flattened above, and feebly shining. Above and beneath pale yellow, with the head, tips of antennal joints, sides of sternum, tips of femora, numerous irregular spots on pronotum, and three broad, transverse, zigzag fasciae on each elytron, black.

Head coarsely, confluent punctate, glabrous, front rather strongly constricted by the eyes, with a narrow, longitudinal, median groove, broadly concave between the antennal tubercles, which are widely separated, and rather strongly elevated; eyes large, strongly convex, feebly emarginate, and widely separated from each other on the top. Antenna about one and one-half times as long as the body, sparsely clothed with short, inconspicuous pubescence, with numerous long, erect hairs on the underside of the joints, which are slightly flattened, but unarmed at apices; first joint robust, cylindrical, arcuate, slightly expanded toward apex, and one-half as long as the third joint, which is distinctly longer than the fourth; eleventh joint subequal in length to the tenth.

Pronotum distinctly longer than wide, and subequal in width at base and apex; sides feebly, arcuately rounded, slightly constricted at base; disk slightly uneven, and more or less flattened; surface glabrous, densely, coarsely, irregularly ocellate-punctate, irregularly scabrous, and ornamented with black or dark brown spots as follows: A narrow, longitudinal, median vitta, extending from anterior margin to middle, where it is divided into two longitudinal vittae, which

extend to, or nearly to, the base, and from two to four round or elongate spots on each side. Scutellum transverse, broadly rounded at apex, and the surface glabrous.

Elytra two and one-half times as long as pronotum, and at base feebly wider than pronotum at middle; humeri rather strongly elevated; sides nearly parallel from base to near the tips, which are separately, rather narrowly rounded; surface coarsely, densely punctate, scabrous in basal regions, with a very short, inconspicuous hair in the center of each puncture, each elytron ornamented with three broad, transverse, zigzag fasciae, one near base, one at middle, and the other one at apical fourth.

Abdomen beneath feebly, sparsely punctate, and clothed with a few long, semierect hairs; last segment broadly rounded at apex. Prosternum broadly, transversely concave, glabrous, feebly, coarsely rugose; prosternal process rather narrow between the coxal cavities, and strongly declivous posteriorly. Legs rather long, glabrous; femora strongly, abruptly clavate, petiolate at bases, and each femur armed with a short tooth on underside near the apex; tibiae slightly flattened, and the anterior pair feebly arcuate.

Female.—Differs from the male in having the antennae only slightly longer than the body, pronotum about as wide as long, and the surface coarsely, uniformly scabrous.

Length, 5–10 mm.; width, 1.4–2.8 mm.

Type locality.—Santiago de las Vegas, Cuba.

Type, allotype, and paratypes.—U.S.N.M. No. 43736.

Paratypes.—In American Museum of Natural History and in S. C. Bruner collection.

Remarks.—Described from eight examples (one type). All these examples, labeled "No. 9399," emerged from some specimens of native wood sent to the Department of Botany, Estacion Experimental Agronomica, at Santiago de las Vegas, Province of Habana, Cuba. Two of them were collected September 6 and 17, 1930, by A. Otero, and the other six were found dead in the Botanical Department, November 29, 1930, by J. Acuña.

This species is allied to *femoratus* Fabricius, but it differs from that species in having nearly all the antennal joints black at the tips, the pronotum ornamented with black spots (anterior part black in *femoratus*), tips of the femora black, and each elytron ornamented with three transverse, zigzag, black fasciae.

OPHISTOMIS INSULARIS, new species

Female.—Elongate, strongly attenuate posteriorly, and subopaque. Black, except the underside of head, a transverse spot on upperside of head in front of antennae, pronotum, medium third of elytra,

prosternum (except prosternal process and a spot in front of each coxa), basal halves of femora, anterior and middle coxae, a transverse fascia on first abdominal segment, and the third and fourth abdominal segments, pale yellow.

Head elongate, coarsely, densely, irregularly punctate, and densely clothed, especially on vertex, with fine, erect, inconspicuous pubescence, front broadly flattened behind epistoma, deeply, longitudinally grooved between the antennal tubercles, which are narrowly separated and strongly elevated, broadly flattened on vertex, and strongly constricted behind the eyes, which are large, strongly convex, and feebly emarginate. Antenna about one-half as long as body, joints cylindrical, and rather densely pubescent.

Pronotum campanulate, wider at base than long, and twice as wide at base as at apex; sides sinuate, strongly diverging from apex to posterior angles, which are prolonged and fitted closely to the elytra; disk moderately convex, and strongly, transversely depressed near anterior margin; surface rather densely, feebly punctate, and rather densely clothed with long, semierect, yellow hairs. Scutellum elongate, acute at apex, and densely clothed with semierect, blackish hairs.

Elytra strongly acuminate, four times as long as pronotum, and at base distinctly wider than pronotum; humeri strongly elevated; sides strongly, obliquely narrowed from base to the tips, which are separately, feebly, obliquely emarginate, with the lateral spine distinctly longer than the sutural one; disk broadly flattened, with a distinct, broadly rounded costa on each elytron, extending from humerus to apex; surface very densely, finely punctate, and densely clothed with long, semierect pubescence, which nearly conceals the surface.

Abdomen beneath sparsely, finely punctate, and clothed with a few erect, inconspicuous hairs; last segment triangularly concave posteriorly, broadly subtruncate at apex, with a distinct tooth on each side. Prosternum smooth; prosternal process very narrow between the coxal cavities, and strongly, arcuately declivous posteriorly. Mesosternum broad, and gibbose between the coxal cavities.

Length, 12 mm.; width, 4 mm.

Type locality.—Dominica, Leeward Islands.

Type.—U.S.N.M. No. 43737. Collected by H. W. Foote, on the Yale Expedition to Dominica, during June and July, 1913.

Paratype.—In American Museum of Natural History. Collected at Long Ditton, Dominica, British West Indies, June 21, 1911.

Remarks.—Described from the type and paratype.

The paratype differs slightly from the type in having the posterior coxae, median part of first abdominal segment, and the last abdominal segment (except the extreme tip) pale yellow.

This species is very closely allied to *thoracica* Fleutiaux and Sallé, described from Guadeloupe, but it differs from that species in being black, with pale yellow markings, pronotum entirely pale yellow, without a longitudinal, elevated, median line, scutellum black, and the femora black, with the basal halves yellow. This may prove to be only a color variety of *thoracica*, when more material is available for study.

NEOCLYTUS PALLIDICORNIS, new species

Female.—Small, elongate, rather robust, subcylindrical, uniformly black, except the antennae and tarsi, which are pale reddish yellow; elytra ornamented with white pubescent markings.

Head coarsely, confluent ocellate-punctate, rather densely clothed with short, erect, white hairs, front as long as wide, flat between the antennal tubercles, which are vaguely elevated; eyes round, rather small, feebly emarginate, and moderately convex. Antenna extending slightly beyond base of elytra, and the outer joints strongly enlarged; first joint long, cylindrical, slightly enlarged toward apex, as long as the third and fourth joints united, which are subequal in length.

Pronotum distinctly wider than long, subequal in width at base and apex, and widest at middle; sides strongly, arcuately rounded, narrowly constricted at base; disk strongly convex, slightly uneven, with four strongly elevated, transverse, median ridges, the second ridge from anterior margin not quite so distinct as the other ridges; surface densely, finely ocellate-punctate, anterior half sparsely clothed with short, recumbent, white hairs, which do not conceal the surface, basal half sparsely clothed with fine, erect, inconspicuous, black hairs. Scutellum triangular, broadly rounded at apex, and sparsely pubescent.

Elytra two and one-half times as long as pronotum, and at base subequal in width to the pronotum at middle; sides feebly narrowed from base to apical fifth, then arcuately narrowed to the tips, which are conjointly, deeply, broadly, arcuately emarginate; disk strongly convex; surface very finely, densely punctate, or granulose, rather densely clothed with very short, inconspicuous, black pubescence, and each elytron ornamented with short, recumbent, white pubescence as follows: A narrow fascia extending obliquely backward from the humerus to the sutural margin near middle, numerous irregularly distributed hairs between it and the scutellum, a V-shaped fascia at middle near lateral margin, a transverse fascia behind

middle, connected to a narrow vitta extending backward along the sutural margin, and covering the extreme apical part. (Example badly rubbed, but punctured area shows pubescent design.)

Abdomen beneath partially destroyed; last segment broadly rounded at apex. Prosternum feebly, coarsely rugose at middle, coarsely ocellate-punctate at sides, sparsely clothed with rather broad, semierect, white hairs, with a few fine, erect hairs intermixed; prosternal process rather broad, slightly expanded behind the coxal cavities, broadly, transversely truncate at apex. Legs robust, coarsely scabrous, sparsely clothed with long, stiff, erect, white hairs, posterior pair long; femora strongly, abruptly clavate, petiolate at bases, middle and posterior pairs bispinose at the tips, and the posterior pair extending slightly beyond the tips of the elytra; posterior tibiae long, subcylindrical.

Length, 9 mm.; width, 3.2 mm.

Type locality.—La Vanneau, Haiti.

Type.—U.S.N.M. No. 43738. A unique female collected June 19, 1915, by W. A. Hoffman.

Remarks.—Described from the type.

This species resembles *araneiformis* Olivier, but it differs from that species in being entirely black, except the tarsi and antennae, which are pale reddish yellow, and in the pronotum having only a single median row of elevated ridges.

NEOCLYTUS PUBICOLLIS, new species

Small, elongate, subcylindrical, pale reddish brown, except the base of the pronotum, basal third of each elytron, mesosternum, and metasternum, which are dark brown; elytra ornamented with whitish pubescent markings.

Head coarsely, densely ocellate-punctate, sparsely clothed with semierect, whitish pubescence, front as long as wide, flat between the antennal tubercles, which are slightly elevated; eyes round, rather small, feebly emarginate, and moderately convex. Antenna extending to basal third of elytra, and the outer joints considerably enlarged; first joint long, cylindrical, slightly enlarged toward apex, twice as long as the third joint, which is distinctly longer than the fourth.

Pronotum distinctly wider than long, subequal in width at base and apex, and widest at middle; sides strongly, arcuately rounded, narrowly constricted at base; disk moderately convex, slightly uneven, with four strongly elevated, median ridges, the second ridge from the anterior margin divided into two small spots, the other three ridges transverse; surface densely granulose, densely clothed with

long, recumbent, yellowish-white pubescence, which conceals the surface. Scutellum transverse, broadly rounded at apex, and sparsely clothed with fine, black pubescence.

Elytra two and one-half times as long as pronotum, and at base subequal in width to the pronotum at middle; sides slightly narrowed from base to the tips, which are separately, obliquely truncate, bispinose, with the lateral spine much longer than the sutural one; disk strongly convex; surface finely, confluent punctate, the punctures coarser in basal regions, rather densely clothed with short, semierect, inconspicuous pubescence, and each elytron ornamented with short, recumbent, whitish pubescence as follows: A transverse, more or less interrupted, broad fascia at middle, narrowly connected along sutural and lateral margins to a straight, broad, transverse fascia behind the middle, and a large spot covering the apical sixth.

Abdomen beneath feebly, coarsely punctate, sparsely clothed with long, fine, semierect hairs, with a spot of broader, white hairs at sides of basal segments; last segment broadly subtruncate at apex. Prosternum finely, feebly rugose, rather densely clothed with short, broad, recumbent, white hairs, which are denser at the sides, and with a few long, erect, inconspicuous hairs intermixed; prosternal process rather narrow, slightly expanded posteriorly, and truncate at apex. Legs robust, feebly rugose, sparsely clothed with short, stiff, semierect, black and white hairs; posterior pair long; femora strongly, abruptly clavate, petiolate at bases, middle and posterior pairs bispinose at tips, and the posterior pair extending slightly beyond the tips of the elytra; posterior tibiae long, and moderately expanded.

Length, 7 mm.; width, 2 mm.

Type locality.—Guantanamo, Cuba.

Type.—U.S.N.M. No. 43739. A unique example (sex not determined), received from S. C. Bruner, and collected June 3, 1916, by C. T. Ramsden.

Remarks.—Described from the type. This species is allied to *pallidicornis* Fisher, but it differs from that species in coloration, in the different arrangement of the pubescent markings on the elytra, and in having the pronotum densely clothed with recumbent, yellowish-white pubescence.

TILLOCLYTUS BRUNERI, new species

Female.—Small, elongate, feebly shining, moderately convex above, except the basal third of elytra, which is slightly depressed. Above blue-black, each elytron with a narrow, transverse, whitish pubescent fascia in front of middle, which does not extend to the sutural margin; beneath dark reddish brown, with the tarsi paler; antennae brownish yellow, with the basal joint dark brown.

Head vaguely granulose, coarsely, sparsely, feebly punctate, clothed with a few long, erect, inconspicuous hairs, front wider than long, flat between the antennal tubercles, which are widely separated, and slightly elevated; eyes small, oblong, rather strongly convex, and not emarginate. Antenna slightly shorter than the body (in male as long as the body), sparsely clothed with moderately long, erect hairs, outer joints slightly flattened; joints 3 to 6 cylindrical, and slightly expanded at tips; first joint long, feebly arcuate, cylindrical, slightly expanded toward apex, considerably longer than the third joint, which is slightly longer than the fourth.

Pronotum nearly one-half longer than wide, distinctly narrower at base than at apex, and widest along apical half; sides nearly parallel from apex to middle, arcuately narrowed to basal third, where they are strongly constricted, then nearly parallel to the base; disk strongly convex anteriorly, strongly, transversely, abruptly depressed on basal third; surface sparsely, finely granulose anteriorly, smooth posteriorly, and clothed with a few long, fine, erect, white hairs. Scutellum very small, elongate, and rather acute at apex.

Elytra one and three-fourths times as long as pronotum, at base slightly wider than pronotum at apical third, and widest at apical third; sides slightly diverging from base to apical third, then arcuately narrowed to the tips, which are conjointly, broadly rounded; disk strongly convex posteriorly, slightly depressed on basal third; surface nearly glabrous, except in the scutellar regions, where it is coarsely, densely punctate, sparsely and irregularly clothed with long, rather stiff, erect, white hairs.

Abdomen beneath feebly, sparsely punctate, sparsely clothed with short, recumbent, inconspicuous hairs; last segment broadly rounded at apex. Prosternum feebly punctate, feebly, transversely rugose anteriorly, and clothed with a few inconspicuous, erect hairs; prosternal process very narrow between the coxal cavities, strongly expanded posteriorly, and truncate at apex. Mesosternum and metasternum with an elongate spot of dense, recumbent, white pubescence on each side. Legs rather long, and sparsely clothed with long, erect, white hairs; femora strongly, abruptly clavate toward the tips, petiolate at bases; tibiae long, and subcylindrical.

Length, 6 mm.; width, 1.6 mm.

Type locality.—Sierra Maestra, Cuba.

Other locality.—Pico Turquino, Cuba.

Type, allotype, and paratype.—U.S.N.M. No. 43740.

Paratype.—In S. C. Bruner collection.

Remarks.—Described from four examples: The type and allotype, collected at the type locality, at an altitude of between 1,100 and 1,300 meters, between July 10 and 20, 1922, by C. H. Ballou and S. C.

Bruner; and two paratypes, collected at Pico Turquino, Cuba, July 20, 1922, by the same collectors.

This species is allied to *nivicinctus* Chevrolat, but it differs from that species in being uniformly bluish black above, and each elytron ornamented with a short, transverse, whitish pubescent fascia, which does not extend to the sutural margin.

TILLOCLYTUS MINUTUS, new species

Female.—Small, elongate, slightly depressed above, nearly glabrous, and subopaque. Above bluish black, each elytron with a broad, transverse, white fascia at middle, the fascia arcuately emarginate in front at sutural margin, and connected posteriorly to a yellow vitta extending along the sutural margin to apex; antennae and underside of body dark brown, the legs and basal joints of antennae slightly paler.

Head glabrous, rather coarsely, confluent punctate, front wider than long, flat between the antennal tubercles, which are widely separated, but not elevated; eyes small, oblong, rather strongly convex, and not emarginate. Antenna extending to basal third of elytra, and the outer joints slightly enlarged; first joint long, feebly arcuate, cylindrical, slightly expanded toward apex, and subequal in length to the third and fourth joints united; third joint twice as long as the fourth, which is distinctly shorter than the fifth.

Pronotum nearly one-half longer than wide, distinctly narrower at base than at apex, and widest near apical third; sides feebly, arcuately rounded from apex to behind middle, then strongly narrowed to the base; disk rather strongly convex anteriorly, and transversely depressed on basal third; surface coarsely, deeply alveolate-punctate, and clothed with a few long, erect, stiff, white hairs. Scutellum small, elongate, rounded at apex, and slightly pubescent.

Elytra one and three-fourths times as long as pronotum, and at base slightly wider than pronotum at apical third; sides nearly parallel from base to behind middle, where they are feebly, arcuately expanded, then strongly, arcuately narrowed to the tips, which are conjointly, broadly rounded; disk strongly flattened on basal halves, strongly convex on apical halves; surface coarsely, deeply alveolate-punctate, with a few long, erect, stiff, white hairs posteriorly, and each elytron with a narrow vitta of short, recumbent, whitish hairs along the sutural margin near apex.

Abdomen beneath smooth, shining, and nearly glabrous; last segment broadly rounded at apex. Prosternum very sparsely, feebly, coarsely punctate, and nearly glabrous; prosternal process very narrow between the coxal cavities, strongly expanded posteriorly, and truncate at apex. Metasternum and mesosternum with a small spot

of dense, recumbent, white pubescence on each side. Legs rather long, smooth, and clothed with a few scattered, long, erect, white hairs; femora strongly, abruptly clavate toward tips, petiolate at bases; tibiae long, and subcylindrical.

Length, 4.8 mm.; width, 1 mm.

Type locality.—Tallaboa, near Ponce, Porto Rico.

Type.—In American Museum of Natural History.

Paratype.—U.S.N.M. No. 43741.

Remarks.—Described from two females (one type) received from the American Museum of Natural History, which were collected by beating and sweeping, at the type locality, July 23, 1914, by H. G. Barber.

This species can be easily separated from *nivicinctus* Chevrolat in having the upper surface bluish black, coarsely alveolate-punctate, nearly glabrous, and by the different markings on the elytra.

TILLOCLYTUS CUBAE, new species

Small, elongate, slightly depressed above, opaque, and the pronotum pubescent. Above black, each elytron with a rather broad, transverse, feebly arcuate, white fascia near middle, the fascia wider at lateral margin than at sutural margin, posterior half of elytron yellow, the anterior margin of the yellow area extending obliquely backward from the white fascia at sutural margin to the lateral margin at apical third, inclosing a triangular, black spot behind the white fascia; beneath dark reddish brown, tarsi paler, last three abdominal segments pale yellow, and basal halves of the middle and posterior femora white; antenna brownish yellow, with the basal and two apical joints dark brown.

Head coarsely, densely ocellate-punctate, and rather densely clothed with long, recumbent, whitish pubescence, front distinctly wider than long, vaguely convex, flat between the antennal tubercles, which are widely separated, and slightly elevated; eyes small, oblong, rather strongly convex, and slightly emarginate. Antenna slightly longer than the body, joints cylindrical, sparsely clothed with long, fine, erect hairs; joints 3 to 6 slightly enlarged at tips; first joint robust, cylindrical, feebly, gradually enlarged toward apex, slightly longer than the third joint, which is subequal in length to the fourth.

Pronotum slightly wider than long, subequal in width at base and apex, and widest at middle; sides strongly, arcuately rounded; disk moderately convex, even; surface densely, coarsely ocellate-punctate, and rather densely clothed with very long, fine, semierect, white hairs, which partially conceal the surface. Scutellum small, triangular, and narrowly truncate at apex.

Elytra two and one-half times as long as pronotum, and at base about as wide as pronotum at middle; sides parallel from base to near the tips, which are conjointly, broadly rounded; disk slightly flattened above; surface coarsely, confluent punctate, and clothed with a few erect, inconspicuous hairs.

Abdomen beneath vaguely granulose, sparsely, feebly punctate, and sparsely clothed with long, inconspicuous hairs; last segment broadly subtruncate at apex. Prosternum sparsely, coarsely punctate, and clothed with a few inconspicuous hairs; prosternal process very narrow between the coxal cavities, not expanded posteriorly, and acute at apex. Legs long, sparsely clothed with long, erect hairs. Femora strongly, abruptly clavate toward tips, petiolate at bases; anterior pair short, straight, and the clubs globose; middle and anterior pairs long, arcuate, and the clubs elongate. Tibiae long, and subcylindrical.

Length, 5.6 mm.; width, 1.6 mm.

Type locality.—Pinares, Oriente, Cuba.

Type.—U.S.N.M. No. 43742. A unique example (sex not determined) collected by William M. Mann.

Remarks.—Described from the type.

This species differs from the other species of this genus in having the pronotum wider than long, uniformly, arcuately rounded at the sides, and the antennae distinctly longer than the body.

PENTANODES ALBOFASCIATUS, new species

Male.—Small, elongate, slightly depressed above, opaque, except basal halves of elytra, which are shining. Head, pronotum, sutural regions of elytra, and antennae (except joints 3 to 5, which are yellowish) reddish; body beneath yellowish, abdomen black, and the legs reddish.

Head finely granulose, sparsely, coarsely, irregularly punctate, sparsely clothed with moderately long, recumbent and erect, white hairs, front wider than long, even, flat between the antennal tubercles, which are widely separated, but not elevated; eyes round, slightly convex, and feebly emarginate. Antenna as long as the body, clothed with a few long, erect, white hairs, and joints 3 to 5 abnormally enlarged; first joint rather short, slightly robust, cylindrical, not enlarged toward apex, three-fifths as long as the third joint, which is strongly arcuate, slender at base, and strongly clavate toward apex; fourth joint one-half as long as the third, and globose; fifth joint slightly longer than the fourth, and narrowly oblong; following joint slender, cylindrical, and gradually diminishing in length toward tip of antenna.

Pronotum one-fourth longer than wide, narrower at base than at apex, and widest at middle; sides feebly, arcuately rounded from

apex to basal sixth, where they are slightly constricted, then parallel to the base; disk rather strongly convex, vaguely, transversely depressed along basal sixth; surface vaguely, finely granulose, feebly, sparsely, irregularly punctate, and sparsely clothed with long, erect, white hairs. Scutellum very small, broadly rounded at apex, and glabrous.

Elytra twice as long as pronotum, and at base subequal in width to the pronotum at middle; sides parallel from base to apical third, then arcuately narrowed to the tips, which are separately, narrowly subtruncate, or vaguely emarginate; disk slightly flattened above; surface shining, vaguely rugose, and punctate on basal halves, opaque, finely, densely punctate, with a few coarse punctures intermixed on apical halves, and each elytron ornamented with white pubescence as follows: A narrow, transverse fascia of dense, long, recumbent pubescence in front of middle, the fascia extending from lateral margin to sutural margin, in front of fascia are a few long, erect hairs, and the apical fourth sparsely clothed with long and short erect hairs.

Abdomen beneath finely, vaguely punctate, and very sparsely, irregularly clothed with short, recumbent, inconspicuous pubescence, with a few long, erect, white hairs intermixed; last segment broadly subtruncate at apex. Prosternum smooth and nearly glabrous; prosternal process very narrow between the coxal cavities, strongly expanded posteriorly, and truncate at apex. Legs rather long, sparsely clothed with long, erect, white hairs; femora petiolate at bases, rather strongly clavate toward tips, the clubs of posterior pair more elongate than those of the middle and anterior pairs; tibiae long, subcylindrical.

Length, 5 mm.; width, 1.6 mm.

Type locality.—Cardenas, Cuba.

Type.—U.S.N.M. No. 43743. A unique male collected by William M. Mann.

Remarks.—Described from the type.

This species resembles *Tilloclytus nivicinctus* Chevrolat very closely, but it differs from that species in having the pronotum very finely granulose, opaque, not abruptly constricted near base, basal halves of elytra vaguely punctured, shining, the surface not white under the transverse pubescent fascia, and by the male having the third, fourth, and fifth antennal joints abnormally expanded.

CALLICLYTUS, new genus

Head small, with the front vertical and wider than long. Mandibles very short, arcuate, and rather acute at apices. Ligula membranous. Palpi 3-jointed, very short, equal in length, and the apical

joints triangular. Cheeks very short. Antenna shorter than body in both sexes, filiform, not spinose, nor ciliate beneath; first joint cylindrical, without a cicatrix at apex, and subequal in length to the third joint. Eyes large, finely granulated, and deeply emarginate. Pronotum about as long as wide, oval, strongly convex, unarmed at sides and on disk. Scutellum small, and triangular. Elytra elongate, expanded posteriorly, and subtruncate at apices. Abdomen globose, the segments unequal in length. Prosternal process rather narrow between the coxal cavities, arcuately declivous posteriorly. Anterior coxae moderately large, globose, not angulated externally, and the cavities closed posteriorly. Intermediate coxal cavities closed externally. Legs unequal in length; tibiae not longitudinally carinate; femora petiolate at bases, strongly clavate and unarmed at apices; posterior tarsus with the first joint subequal in length to the following two joints united. Body slightly pubescent.

Genotype.—*Calliclytus schwarzi*, new species.

This genus belongs to the tribe Tillomorphini and is allied to *Tillomorpha* Blanchard, but it differs from that genus in having the antennae distinctly shorter than the body, palpi very short, subequal in length, and the apical joints triangular, pronotum as wide as long, elytra with eburneous fasciae, and the abdomen globose.

CALLICLYTUS SCHWARZI, new species

Male.—Elongate, moderately convex above, strongly shining, reddish brown, except the apical two-thirds of the elytra and abdomen, which are black, the posterior tibiae and femora brownish black, and each elytron ornamented with a transverse, eburneous fascia.

Head with the front strongly transverse, even, flat between the antennal tubercles, which are small, very widely separated, and scarcely elevated, feebly, densely, coarsely punctate, sparsely clothed with moderately long, inconspicuous, erect and recumbent, whitish hairs; eyes separated from each other on the top by about five times the width of the upper lobe. Antenna (last two apical joints missing) distinctly shorter than body, basal joints clothed with a few long, erect, rather stiff, white hairs, apical joints rather densely clothed with short, recumbent, whitish pubescence, the joint feebly expanded toward the tips; first joint robust, cylindrical, subequal in length to the third joint, which is twice as long as the second; joints 4 and 5 each subequal in length to the third, and the following joints gradually diminishing in length.

Pronotum as wide as long, slightly wider at apex than at base, widest at middle; sides strongly, arcuately rounded, narrowly constricted at base; disk even, uniformly, strongly convex; surface coarsely, closely, irregularly, longitudinally rugose, the rugae broken

and forming more or less distinct elongate cells, and sparsely clothed with short, semierect, inconspicuous pubescence, with numerous long, erect, white hairs intermixed. Scutellum elongate-triangular, glabrous, longitudinally concave, and rounded at apex.

Elytra twice as long as pronotum, at base slightly narrower than pronotum at middle, and widest at apical third; humeri not strongly developed; sides parallel near base, broadly, arcuately constricted at middle, broadly, arcuately expanded at apical third, and the tips broadly subtruncate; disk broadly, transversely depressed at middle, strongly convex posteriorly, and strongly, broadly elevated along the sutural margins at basal fourth; surface densely, coarsely, deeply, irregularly punctate, sparsely, irregularly clothed with long, erect, white hairs of different lengths, the hairs denser on apical halves, and each elytron ornamented in front of middle with a narrow, transverse, eburneous fascia, extending from lateral margin to near the sutural margin.

Abdomen beneath very sparsely, irregularly punctate, sparsely clothed with long, erect, white hairs, and the posterior margin of each segment narrowly yellow; first segment subequal in length to the following three segments united; last segment narrow, and broadly rounded at apex. Prosternum coarsely, deeply, irregularly punctate, and sparsely clothed with short, recumbent, white pubescence; prosternal process narrow, strongly expanded behind the coxal cavities, and feebly emarginate at apex. Legs sparsely clothed with long, erect, white hairs; anterior pair slightly shorter than middle and posterior pairs; tibiae straight and cylindrical.

Length, 5 mm.; width, 1.6 mm.

Type locality.—Cayamas, Cuba.

Type.—U.S.N.M. No. 43744. A unique male collected May 10, by E. A. Schwarz.

Remarks.—Described from the type.

LAMPROCLYTUS, new genus

Head small, with the front vertical, and wider than long. Mandibles very short, arcuate, and acute at apices. Ligula membranous. Palpi 3-jointed, very short, subequal in length, the apical joints broadly elongate, parallel, and truncate at tips. Cheeks very short. Antenna 10-jointed, distinctly shorter than body, filiform, gradually expanded toward apex, but not clavate, not spinose, nor ciliate beneath; first joint cylindrical, without a cicatrix at apex, and longer than the third joint. Eyes large, finely granulated, and deeply emarginate. Pronotum longer than wide, strongly convex, unarmed at sides and on disk. Scutellum small and triangular.

Elytra elongate, nearly parallel, and broadly rounded or subtruncate at apices. Abdomen elongate, and the segments unequal in length. Prosternal process rather narrow between the coxal cavities, and arcuately declivous posteriorly. Anterior coxae moderately large, globose, not angulated externally, and the cavities closed posteriorly. Intermediate coxal cavities closed externally. Legs unequal in length; tibiae not longitudinally carinate; femora petiolate at bases, strongly clavate and unarmed at apices; posterior tarsus broad, with the first joint scarcely longer than the second. Body vaguely pubescent.

Genotype.—*Lamproclytus elegans*, new species.

This genus belongs to the tribe Tillomorphini and is allied to *Tillomorpha* Blanchard, but it differs from that genus in having the antenna 10-jointed, distinctly shorter than the body, gradually expanded toward the tip, and the first joint short, palpi very short and subequal in length, elytra with eburneous fasciae, and the first joint of the posterior tarsus distinctly longer than the second joint.

LAMPROCLYTUS ELEGANS, new species

Female.—Elongate, nearly parallel, moderately convex above, strongly shining, black, except basal third of each elytron, basal joint of antenna, mesosternum, metasternum, and basal halves of femora, which are brownish yellow, and each elytron ornamented with a transverse, eburneous fascia.

Head with the front strongly transverse, even, flat between the antennal tubercles, which are small, very widely separated, and scarcely elevated, coarsely alveolate-punctate, sparsely clothed with moderately long, semierect, white hairs; eyes separated from each other on the top by four times the width of the upper lobe. Antenna extending just beyond base of elytron, basal joints cylindrical, feebly expanded toward tips, clothed with a few long, erect, white hairs, apical joints broader, slightly flattened, rather densely clothed with short, recumbent pubescence, with a few long, erect hairs intermixed; first joint robust, cylindrical, two and one-half times as long as the second joint, which is two-thirds as long as the third; joints 4 and 5 twice as long as the second; joints 6 and 7 subequal in length to the third joint, and subtriangular; joints 8 and 9 subequal in length to the second joint, and as wide as long; tenth joint oval, subequal in length to the third, and acute at apex.

Pronotum distinctly longer than wide, slightly wider at apex than at base, and widest at middle; sides strongly, arcuately rounded from apex to basal sixth, where they are strongly constricted, then parallel to the base; disk even, strongly convex, broadly, feebly, transversely depressed along apex, and strongly, transversely constricted

at base; surface coarsely alveolate-punctate, sparsely clothed with long, erect, stiff, white hairs. Scutellum elongate-triangular, and sparsely clothed with short, recumbent pubescence.

Elytra two and one-third times as long as pronotum, and at base feebly wider than pronotum at middle; humeri feebly developed; sides nearly parallel, feebly, very broadly, arcuately constricted at middle, the tips separately, broadly rounded or subtruncate; disk feebly, broadly, transversely depressed at middle, and vaguely, broadly elevated along sutural margins at basal fourth; surface very coarsely, deeply, densely punctate, clothed with a few long, erect, stiff, white hairs, and each elytron ornamented behind the middle with a narrow, transverse, eburneous fascia, extending from lateral margin to near the sutural margin.

Abdomen beneath very sparsely, feebly, coarsely punctate, and clothed with a few long, erect, white hairs; last segment broadly rounded at apex. Prosternum sparsely, coarsely punctate, feebly, transversely rugose, and clothed with a few erect, white hairs; prosternal process narrow, expanded behind the coxal cavities. Legs sparsely clothed with long, erect, stiff, white hairs, and the anterior pair slightly shorter than the middle and posterior pairs; tibiae straight and subcylindrical.

Length, 3.8 mm.; width, 1 mm.

Type locality.—Bayamon, Porto Rico.

Type.—U.S.N.M. No. 43745. A unique female collected by R. C. Shannon.

Remarks.—Described from the type.

TRICHOUS VITTATUS, new species

Broadly elongate, subparallel, subopaque, and slightly flattened above. Front of head yellow, antennae and posterior part of head black, thorax red, with a distinct orange-yellow tinge, elytra black, and each elytron ornamented with a moderately broad, yellowish white, longitudinal vitta extending from middle of base to near the apex, underside of body yellowish brown, with the tarsi, upper side of tibiae, and spot near the tip of each femur, black.

Head strongly transverse, and nearly flat in front, feebly concave between the antennal tubercles, which are widely separated and feebly elevated, the surface nearly glabrous, sparsely, coarsely, irregularly punctate, the punctures denser on occiput; eyes large, strongly convex, deeply emarginate, and separated from each other on the top by three times the width of the upper lobe. Antenna as long as the body, rather densely clothed with short, recumbent, black pubescence, with a few long, erect hairs on the underside of the basal joints; joints 3 to 7 unispinose at apices; first joint rather short,

robust, slightly clavate toward apex, five-eighths as long as the third joint, which is twice as long as the fourth; eleventh joint subequal in length to the tenth.

Pronotum slightly wider than long, subequal in width at base and apex, and widest at middle; sides strongly, arcuately rounded, slightly more obliquely narrowed posteriorly; disk moderately, regularly convex; surface glabrous, very coarsely, deeply, confluent punctate. Scutellum triangular, rather acutely rounded at apex; surface glabrous and longitudinally concave.

Elytra three and one-half times as long as pronotum, and at base distinctly wider than pronotum at middle; sides parallel from base to near the tips, which are separately, broadly subtruncate, with a distinct, acute tooth at lateral angle; disk moderately flattened above; surface densely, deeply, uniformly punctate, the punctures coarse in basal regions, but becoming slightly finer toward apices, rather densely clothed with long, semierect, inconspicuous pubescence, which is denser and more conspicuous on the longitudinal pale vittae.

Abdomen beneath coarsely, vaguely punctate, sparsely clothed with short, recumbent, white pubescence, with a few long, erect hairs intermixed, the pubescence denser toward the sides and along the apical margins of the segments; last visible segment broadly subtruncate or vaguely emarginate at apex. Prosternum sparsely, coarsely, feebly punctate, and nearly glabrous; prosternal process narrow between the coxal cavities, strongly declivous and expanded posteriorly, and truncate at apex. Legs long, sparsely clothed with semierect hairs; anterior and middle femora rather strongly clavate toward apices, posterior pair feebly expanded; tibiae long and subcylindrical.

Length, 9.5 mm.; width, 3 mm.

Type locality.—Las Animas, Sierra Rangel, Cuba.

Type.—U.S.N.M. No. 43746. A unique example (sex not determined) collected by Brother Roberto, of the La Salle School, Habana, at Las Animas, Sierra Rangel, in the Province of Pinar del Rio, Cuba, during July, 1930, and labeled "Estacion Experimental Agronomica, Cuba, No. 9445."

Remarks.—Described from the type.

This species is allied to *lineolatus* White, but it differs from that species in having the head yellow in front and black on the top, pronotum densely punctured, and the legs not entirely black.

TRICHOUS BICOLOR, new species

Female.—Broadly elongate, subopaque, moderately flattened above. Head, thorax, basal joints of antennae, basal two-thirds of elytra, underside of body, and femora, pale reddish brown; tibiae and tarsi

dark reddish brown; antenna, except basal joint, and apical third of each elytron, black.

Head strongly transverse and nearly flat in front, with a narrow, median, longitudinal groove, flat between the antennal tubercles, which are widely separated and feebly elevated, the surface coarsely, deeply, confluent punctate, and clothed with a few long, erect, inconspicuous hairs; eyes large, strongly convex, deeply emarginate, and separated from each other on the top by four times the width of the upper lobe. Antenna not quite so long as the body, basal joints coarsely punctate, sparsely clothed with short, black pubescence, with a few long, erect hairs on the underside of the joints, outer joints more or less flattened, finely punctate, and densely clothed with short, recumbent pubescence; joints 3 to 7 unispinose at apices; first joint robust, cylindrical, feebly clavate toward apex, subequal in length to the third joint, which is twice as long as the fourth; eleventh joint subequal in length to the tenth.

Pronotum distinctly wider than long, subequal in width at base and apex, and widest at middle; sides strongly, arcuately rounded, slightly constricted at base and apex; disk regularly, strongly convex; surface coarsely, deeply alveolate-punctate, with a long, erect hair arising from the center of each puncture. Scutellum triangular, acutely rounded at apex, the surface longitudinally concave and feebly pubescent.

Elytra three times as long as pronotum, and at base distinctly wider than pronotum at middle; sides parallel from base to apical fourth, then arcuately narrowed to the tips, which are separately, broadly truncate, and unarmed at lateral angle; disk moderately convex; surface coarsely, rather densely, deeply, uniformly punctate, and sparsely, uniformly clothed with long, erect, inconspicuous hairs.

Abdomen beneath feebly, sparsely punctate, sparsely clothed with semierect hairs; last segment broadly rounded at apex. Prosternum sparsely, feebly, irregularly punctate, clothed with a few erect hairs; prosternal process narrow between the coxal cavities, strongly declivous and expanded posteriorly, and truncate at apex. Legs long, sparsely clothed with semierect hairs; anterior and middle femora rather strongly clavate toward apices, posterior pair feebly expanded; tibiae long and subcylindrical.

Length, 12 mm.; width, 4.4 mm.

Type locality.—Port au Prince, Haiti.

Type.—U.S.N.M. No. 43747. A unique female, collected in 1899 by R. J. Crew.

Remarks.—Described from the type.

This species resembles *Heterops dimidiata* Chevrolat, but it differs from that species in having the femora clavate and unarmed at the tips, and joints 3 to 7 of the antennae distinctly spinose at the tips.

HETEROPS HISPANIOLAE, new species

Female.—Broadly elongate, subopaque, and moderately flattened above. Head and pronotum dull red, the latter with a median black spot; antennae black; elytra brownish black, more reddish on the basal halves, and each elytron ornamented with two pairs of elongate, eburneous spots; beneath bright reddish brown, with the tarsi, tibiae, and bases of femora, dark reddish brown or blackish.

Head strongly transverse, somewhat uneven, and transversely depressed in front, feebly concave and longitudinally grooved between the antennal tubercles, which are widely separated and feebly elevated, the surface coarsely, irregularly, confluent punctate, more or less rugose, and feebly pubescent; eyes large, strongly convex, deeply emarginate, and separated from each other on the top by four times the width of the upper lobe. Antenna one and one-fourth times as long as the body, rather densely clothed with short, recumbent pubescence, with a few long, erect hairs on the underside of the basal joints; joints unarmed at apices; first joint robust, cylindrical, moderately clavate toward apex, feebly shorter than the third joint, which is subequal in length to the fourth; eleventh joint subequal in length to the tenth.

Pronotum slightly wider than long, subequal in width at base and apex, and widest at middle; sides feebly, arcuately rounded; disk regularly, moderately convex; surface glabrous, coarsely, deeply, irregularly alveolate-punctate. Scutellum subtriangular, elongate, broadly rounded at apex, and the surface even and rather densely pubescent.

Elytra three times as long as pronotum, and at base distinctly wider than pronotum at middle; sides parallel from base to near the tips, which are separately, broadly subtruncate, feebly sinuate, with a more or less distinct tooth at lateral angle; disk moderately convex; surface finely, densely granulose, feebly, irregularly punctate in basal regions, densely clothed with short, recumbent pubescence, which nearly conceals the surface, and each elytron ornamented with two pairs of elongate, eburneous spots, the spots of each pair subequal in length, and in close contact along their entire length, the basal pair usually longer than the median pair.

Abdomen beneath feebly, finely, irregularly punctate, and sparsely clothed with short, recumbent, inconspicuous pubescence; last segment broadly subtruncate at apex. Prosternum broadly, transversely depressed in front, coarsely, irregularly rugose, and sparsely clothed with short, inconspicuous pubescence; prosternal process broad between the coxal cavities, feebly expanded posteriorly, and abruptly declivous at apex. Legs long, nearly glabrous; femora slender,

cylindrical, middle and posterior pairs bispinose at the tips; tibiae long cylindrical, but not longitudinally carinate.

Male.—Differs from the female in having the antennae nearly twice as long as the body, and the prosternum deeply, coarsely, uniformly punctate.

Length, 10–15 mm.; width, 3.2–4.8 mm.

Type locality.—Santo Domingo, Dominican Republic.

Other localities.—Sanchez, Dominican Republic; Port au Prince, Haiti.

Type, allotype, and paratypes.—U.S.N.M. No. 43748.

Paratypes.—In American Museum of Natural History and in Museum of Comparative Zoology.

Remarks.—Described from 8 examples, 4 males and 4 females: The type (female) and allotype, collected at the type locality, June 22 and July 6, 1907, by H. H. Keays; one paratype, collected at Port au Prince, Haiti, in 1899, by R. J. Crew; one paratype, simply labeled "Port-au-Prince, Haiti"; three paratypes, received from the American Museum of Natural History, collected at Sanchez, Dominican Republic, between May 22 and June 22, 1915, by F. E. Watson; and one paratype, received from the Museum of Comparative Zoology, simply labeled "Haiti, P. R. Uhler."

This species shows considerable variation in size and color. In some of the examples examined the pronotum and elytra are almost entirely black, whereas in other examples the black color on the pronotum is reduced to a small spot in front of the scutellum.

It is closely allied to *lanieri* Chevrolat, with which it is confused in most collections, but differs from *lanieri* in having the posterior pair of eburneous spots on each elytron elongate, subequal in length, and in close contact along their entire length, whereas in *lanieri* these spots are rounded, distinctly separated, and the sutural spot of each median pair placed slightly in advance of the lateral spot.

Subfamily LAMIINAE

ATAXIA HAITIENSIS, new species

Female.—Elongate, parallel, brownish black, rather densely clothed with brownish-yellow pubescence, which partially conceals the surface, and irregularly variegated with whitish pubescence.

Head in front strongly transverse, nearly flat, feebly, transversely depressed between the antennal tubercles, which are widely separated and rather strongly elevated, finely, densely punctate, densely clothed with short, recumbent, brownish-yellow and whitish pubescence intermixed; eyes moderately convex, deeply emarginate, and widely separated from each other on the top. Antenna about as long

as the body, densely clothed with short, recumbent, brownish-yellow and whitish pubescence intermixed, with numerous long, erect, white hairs on the underside of the joints; outer joints annulated with white pubescence at bases; first joint robust, oblong, truncate at apex, with a distinct cicatrix, and three-fourths as long as the third joint, which is slightly shorter than the fourth, the following joints gradually diminishing in length.

Pronotum about as wide as long, subequal in width at base and apex, and widest at apical third; sides arcuately rounded in front of middle, obliquely narrowed posteriorly, with an obsolete tubercle on each side at apical third; disk moderately convex; surface finely, densely punctate, with a few coarse punctures intermixed, densely clothed with short, recumbent, brownish-yellow pubescence, with a few short, white hairs intermixed, and ornamented with a narrow, longitudinal, median, white pubescent vitta, extending from anterior margin to base. Scutellum triangular, and broadly rounded at apex.

Elytra nearly four times as long as pronotum, and at base slightly wider than pronotum at apical third; humeral angles broadly rounded; sides nearly parallel from base to apical fifth, then feebly narrowed to the tips, which are separately, broadly, obliquely truncate, with the lateral angle rather acutely produced; disk moderately convex, and each elytron with a vague, longitudinal costa near sutural margin; surface sparsely, coarsely, irregularly punctate, densely clothed with short, recumbent, brownish-yellow and whitish pubescence, the white hairs more numerous on median parts, causing the surface to have a variegated appearance.

Abdomen beneath vaguely, finely punctate, densely clothed with short, recumbent, brownish-yellow and whitish pubescence with a few long, inconspicuous, erect hairs intermixed; last segment broadly subtruncate at the tip, with a broad, concave depression at the apex. Prosternum moderately declivous in front, narrow between the coxal cavities, arcuately declivous, and broadly, triangularly expanded posteriorly. Mesosternum obliquely declivous in front, and feebly elevated between the middle coxal cavities. Legs rather short, densely clothed with short, recumbent, brownish-yellow and whitish pubescence, with a few long, erect hairs intermixed; femora strongly clavate toward the tips, the posterior pair not quite extending to third abdominal segment; tibiae subcylindrical, the posterior pair feebly arcuate.

Length, 13 mm.; width, 3.6 mm.

Type locality.—Hinche, Haiti.

Type.—U.S.N.M. No. 43749. A unique female collected May 20, 1925, by W. A. Hoffmann.

Remarks.—Described from the type.

This species is allied to *spinicauda* Schaeffer, but it differs from that species in having the pronotum ornamented with a longitudinal, median, white, pubescent vitta, and the tips of the elytra not acutely spinose at their outer angles.

ACREPIDOPTERUM PILOSUM, new species

Elongate, rather narrow, and subparallel; above and beneath reddish brown, rather densely clothed with brownish-yellow pubescence, with a few paler hairs intermixed, and the elytra ornamented with dark-brown pubescent markings.

Head in front nearly twice as wide as long, slightly convex, broadly concave between the antennal tubercles, which are widely separated and strongly elevated, coarsely, sparsely, irregularly punctate, densely clothed with long, recumbent, brownish-yellow pubescence, with numerous long, erect, hairs intermixed; eyes small, coarsely granulated, deeply emarginate, and separated from each other on the top by one and one-half times the width of the upper lobe. Antenna slightly longer than the body, pale yellow, joints slightly darker at apices, sparsely clothed with short, recumbent and erect, whitish pubescence, and moderately ciliate beneath; first joint robust, short, oblong, without a cicatrix at apex, slightly longer than the third joint, which is distinctly shorter than the fourth, the following joints gradually diminishing in length.

Pronotum feebly wider than long, subequal in width at base and apex, and widest at middle; sides arcuately rounded; disk even, moderately convex; surface rather densely, coarsely punctate, with a small, smooth, glabrous, medium spot, rather densely clothed with short, recumbent, brownish-yellow and whitish pubescence, with a few long, erect hairs intermixed. Scutellum as wide as long, triangular, narrowly rounded at apex, densely clothed with pale yellow pubescence, except the middle, which is glabrous.

Elytra three times as long as pronotum, and at base slightly wider than pronotum at middle; sides nearly parallel to behind middle, then arcuately narrowed to the tips, which are separately, narrowly rounded; disk feebly, broadly, transversely concave in front of middle, with a feebly elevated gibbosity on each elytron near the base; surface rather densely, irregularly punctate, the punctures coarse on basal halves, but becoming finer and more distant toward the apices, densely clothed with short, recumbent, brownish-yellow and whitish pubescence, with numerous long, erect hairs intermixed, and each elytron ornamented with dark brown pubescence as follows: A short, narrow, oblique fascia behind humerus, extending from basal gibbosity to sutural margin, a very broad, oblique fascia at middle, extending from sutural margin to the

exterior elytral declivity, and a few small spots along the sutural margin at apical fourth.

Abdomen beneath finely, densely punctate, with a few coarse punctures intermixed, densely clothed with short, recumbent, yellowish-white pubescence, with a few long, erect hairs intermixed; last segment broadly rounded at apex. Prosternum very coarsely, sparsely punctate; prosternal process narrow, arcuately declivous in front and behind, and triangularly expanded behind the coxae. Legs rather long, densely clothed with short, recumbent, whitish pubescence, and with numerous long, erect hairs intermixed; femora strongly clavate toward the tips; tibiae subcylindrical, slightly enlarged toward the tips.

Length, 4.2 mm.; with, 1.4 mm.

Type locality.—San Cristobal, Dominican Republic.

Type.—U. S. N. M. No. 43750. A unique example (sex not determined) collected at Blanton mine, north of San Cristobal, Dominican Republic, July 26, 1917 (No. 376), by Harold Morrison.

Remarks.—Described from the type.

This species is closely allied to *minutum* Fisher, but it differs from that species in having the legs and upper surface of the body clothed with long, erect hairs, and in the different arrangement of the dark-brown pubescent markings on the elytra.

ECYRUS INSULARIS, new species

Male.—Elongate, robust, strongly convex above, uniformly brownish black, densely clothed with whitish and brownish pubescence, which conceals the surface, giving it a mottled appearance, the pronotum ornamented with two elongate, yellow, pubescent spots, and each elytron with four tufts of erect hairs, and two yellow pubescent vittae.

Head in front longer than wide, slightly wider at bottom than at top, flat, strongly, angularly depressed between the antennal tubercles, which are narrowly separated and strongly elevated, densely clothed with rather short, recumbent, whitish pubescence, which conceals the surface, and with a longitudinal carina extending from epistoma to occiput; eyes coarsely granulated, deeply emarginate, and nearly contiguous on the top. Antenna considerably longer than body, tips of the joints annulated with brown, surface rather densely clothed with short, recumbent, whitish pubescence, except the first joint, which is mottled with brown pubescence, and all the joints densely ciliate beneath; first joint robust, short, reversed cone-shaped, one-half as long as the fourth joint, which is distinctly longer than the third; fifth joint subequal in length to the first joint, the following joints shorter, and gradually diminishing in length.

Pronotum feebly wider than long, subequal in width at base and apex; sides parallel and rather strongly sinuate; disk uneven, transversely flattened along base and apex, and armed with two acute tubercles, placed transversely at middle; surface concealed by the short, dense, recumbent, white and dark brown pubescence, and ornamented with a large, elongate, pale yellow, pubescent spot on each side of middle, extending from anterior margin to basal third. Scutellum transversely subtriangular, and broadly subtruncate at apex.

Elytra three times as long as pronotum, and at base one-third wider than pronotum at middle; sides gradually narrowed from base to apical fourth, then arcuately narrowed to the tips, which are separately, transversely truncate; disk uneven, and each elytron with three longitudinal costae; surface coarsely punctate, the punctures arranged in double rows between the costae, densely clothed with short, recumbent, whitish, yellowish, and dark brown pubescence intermixed, with a few long, erect, white hairs, and each elytron ornamented with four tufts of long, erect hairs, three placed longitudinally near middle, the other one near humerus, and the two median costae densely clothed posteriorly with pale yellow pubescence.

Abdomen beneath finely, densely punctate, and densely clothed with long, recumbent and erect, whitish pubescence; last segment broadly rounded at apex. Prosternum arcuately declivous in front and behind, and rather narrow between the coxal cavities. Legs rather short, mottled with short, recumbent, whitish and brownish pubescence, with numerous long, erect, white hairs intermixed; femora strongly clavate toward tips; tibiae slender, straight, and subcylindrical.

Length, 6–10 mm.; width, 2.6–4 mm.

Type locality.—Baragua, Cuba.

Other locality.—"Central Jaronú," Cuba.

Type and paratype.—U.S.N.M. No. 43751.

Paratype.—In S. C. Bruner collection.

Remarks.—Described from three males: The type, collected at light, May 6, 1928, by L. C. Scaramuzza, labeled "T. P. R. F. Ent. No. 3418"; and two paratypes, from "Central Jaronú," north coast of Camaguey Province, Cuba, collected May 8, 1926, and June 20, 1926, by B. T. Barreto.

This species is closely allied to *hirtipes* Gahan, but it differs from that species in having two distinct yellow pubescent spots on the pronotum, four tufts of erect hairs and two narrow yellow pubescent vittae on each elytron, the punctures on the elytra much coarser, and without small, black asperities on the pronotum.

ECYRUS HOFFMANNI, new species

Male.—Elongate, robust, strongly convex above, uniformly reddish brown, densely clothed with whitish, brownish, and yellowish pubescence, which nearly conceals the surface, and each elytron ornamented with a tuft of brown hairs near the base.

Head in front longer than wide, subequal in width at bottom and top, flat, strongly, angularly depressed between the antennal tubercles, which are narrowly separated and strongly elevated, sparsely, coarsely punctate, densely clothed with rather short, recumbent, whitish pubescence, which nearly conceals the surface, and with a longitudinal carina extending from occiput to middle of front; eyes coarsely granulated, deeply emarginate, and very narrowly separated from each other on the top. Antenna longer than the body (broken), tips of the joints feebly annulated with brown, surface rather densely clothed with short, recumbent, whitish pubescence, except the first joint, which is clothed with whitish and brownish pubescence, and all the joints densely ciliate beneath; first joint robust, short, reversed cone-shaped, one-half as long as the fourth joint, which is distinctly longer than the third; fifth joint subequal in length to the first joint, the following joints shorter, and gradually diminishing in length.

Pronotum as wide as long, and subequal in width at base and apex; sides parallel, and rather strongly sinuate; disk uneven, transversely flattened along base and apex, transversely grooved at basal fourth, and armed with two acute tubercles placed transversely in front of middle; surface sparsely, coarsely punctate, rather densely clothed with moderately long, recumbent, whitish pubescence, which nearly conceals the surface, and ornamented with pale yellow pubescence around the tubercles. Scutellum subtriangular, broadly rounded at apex, and broadly, deeply concave at base.

Elytra three times as long as pronotum, and at base one-third wider than pronotum at middle; sides feebly, gradually narrowed from base to apical fourth, then arcuately narrowed to the tips, which are separately, feebly, obliquely truncate; disk uneven, and each elytron with three longitudinal costae; surface coarsely, deeply punctate, the punctures widely separated from each other, and arranged in double rows between the costae, densely clothed with short, recumbent, whitish, yellowish, and brownish pubescence, the white pubescence forming a broad, obsolete, transverse fascia at middle, bordered anteriorly by a narrow, oblique fascia of dark brown pubescence, with numerous irregular spaces of pale yellow pubescence, and each elytron ornamented near base with a large tuft of dark brown hairs.

Abdomen beneath feebly, finely, rather sparsely punctate, densely clothed with long, recumbent, whitish pubescence, with a few long,

erect hairs intermixed; last segment broadly subtruncate at apex. Prosternum arcuately declivous in front and behind, rather broad and longitudinally concave between the coxal cavities. Legs short, densely clothed with long, recumbent and erect, whitish pubescence; femora strongly clavate toward tips; tibiae slender, straight, and subcylindrical.

Length, 8 mm.; width, 3.6 mm.

Type locality.—Hinche, Haiti.

Type.—U.S.N.M. No. 43752. A unique male collected May 17, 1925, by W. A. Hoffmann.

Remarks.—Described from the type.

This species is allied to *hirtipes* Gahan and *insularis* Fisher. From the former it differs in not having any asperities on the pronotum, and from *insularis* in having only one tuft of erect hairs on each elytron near the base.

ECYRUS NANUS, new species

Female.—Rather short, robust, strongly convex above, uniformly reddish brown, densely clothed with whitish, brownish, and yellowish pubescence, which nearly conceals the surface, and each elytron ornamented with a rather inconspicuous tuft of erect hairs near the base.

Head in front about as wide as long, slightly wider at bottom than at top, flat, strongly, angularly depressed between the antennal tubercles, which are narrowly separated and strongly elevated, sparsely, coarsely punctate, sparsely clothed with short, recumbent, yellowish-white pubescence, and with a longitudinal carina extending from occiput to middle of front; eyes coarsely granulated, deeply emarginate, and nearly contiguous on the top. Antenna about as long as the body, uniformly pale reddish brown, sparsely clothed with short, recumbent, whitish pubescence, except the first joint, which is mottled with brown pubescence, and all the joints densely ciliate beneath; first joint robust, short, reversed cone-shaped, one-half as long as the fourth joint, which is distinctly longer than the third; fifth joint subequal in length to the first joint, the following joints shorter, and gradually diminishing in length.

Pronotum as wide as long, and subequal in width at base and apex; sides parallel, and rather strongly sinuate; disk uneven, transversely flattened along base and apex, feebly, transversely grooved at basal fourth, and armed with two obtuse tubercles, placed transversely at middle; surface with numerous small, black asperities, rather densely, irregularly clothed with whitish and brownish-yellow pubescence, the pubescence with a vague greenish tinge in certain lights. Scutellum transversely subtriangular, broadly subtruncate at apex, and vaguely concave at base.

Elytra three times as long as pronotum, and at base one-half wider than pronotum at middle; sides nearly parallel from base to apical third, then arcuately narrowed to the tips, which are separately, feebly, obliquely truncate; disk uneven, and each elytron with three longitudinal costae; surface coarsely, deeply punctate, the punctures widely separated from each other, and arranged in double rows between the costae, densely clothed with short, recumbent, whitish, yellowish, and brownish pubescence, with a vague greenish tinge in certain lights, the white pubescence forming a broad, obsolete, obliquely transverse fascia at middle, bordered anteriorly by a narrow, oblique fascia of dark brown pubescence, with numerous irregular spaces of pale yellow pubescence, and each elytron ornamented near base with a tuft of pale brownish hairs.

Abdomen beneath finely, densely punctate, densely clothed with long, recumbent, whitish pubescence, with a few long, erect, white hairs intermixed; last segment broadly rounded at apex. Prosternum arcuately declivous in front and behind, rather narrow and densely pubescent between the coxal cavities. Legs short, densely clothed with long, recumbent and erect, whitish pubescence; femora feebly arcuate, and strongly clavate toward tips; tibiae slender, straight, and subcylindrical.

Length, 6 mm.; width, 2.8 mm.

Type locality.—Boqueron, Porto Rico.

Other locality.—Mayaguez, Porto Rico.

Type.—In American Museum of Natural History. Female, collected February 18, 1930, by C. W. Leng.

Paratype.—U.S.N.M. No. 43753. Female, collected at Mayaguez, Porto Rico, by R. H. Van Zwaluwenburg.

Remarks.—Described from type and paratype.

This species is closely allied to *hoffmanni* Fisher, but it differs from that species in being shorter, and in the pronotum having numerous small round, black asperities.

ECYRUS FLAVUS, new species

Female.—Elongate, robust, strongly convex above, uniformly pale reddish brown, rather densely clothed with short whitish and yellowish pubescence, which partially conceals the surface, and each elytron ornamented with a large tuft of long, erect, brownish-yellow hairs near base, and an indistinct tuft of similar hairs behind the middle.

Head in front about as wide as long, wider at bottom than at top, flat, strongly, angularly depressed between the antennal tubercles, which are narrowly separated and strongly elevated, sparsely, coarsely punctate, sparsely clothed with rather short, recumbent, yellowish-white pubescence, and with a longitudinal carina extending

from occiput to middle of front; eyes coarsely granulated, deeply emarginate, and very narrowly separated from each other on the top. Antenna as long as the body, uniformly pale reddish brown, sparsely clothed with short, recumbent, whitish pubescence, and all the joints densely ciliate beneath; first joint robust, short, reversed cone shaped, one-half as long as the fourth joint, which is distinctly longer than the third; fifth joint subequal in length to the first, the following joints shorter and gradually diminishing in length.

Pronotum slightly wider than long, and subequal in width at base and apex; sides parallel, and rather strongly sinuate; disk uneven, transversely flattened along base and apex, feebly, transversely grooved at basal fourth, and armed with two acute tubercles placed transversely slightly in front of middle; surface with numerous small asperities, rather densely clothed with short, recumbent, brownish-white pubescence. Scutellum subtriangular, and broadly subtruncate at apex.

Elytra three times as long as pronotum, and at base one-third wider than pronotum at middle; sides nearly parallel from base to apical third, then arcuately narrowed to the tips, which are separately, transversely truncate; disk uneven, each elytron with three longitudinal costae; surface coarsely, deeply punctate, the punctures widely separated from each other, and arranged in double rows between the costae, rather densely clothed with short, recumbent, whitish and yellowish pubescence, and each elytron ornamented with a narrow, inconspicuous, obliquely transverse fascia of dark brown pubescence in front of middle, a large tuft of brownish-yellow hairs near base, and an inconspicuous tuft of similar hairs behind the middle.

Abdomen beneath densely clothed with long, recumbent, whitish pubescence, which conceals the surface, and with a few long, erect hairs intermixed; last segment broadly rounded at apex. Prosternum arcuately declivous in front and behind, rather broad and densely pubescent between the coxal cavities. Legs short, densely clothed with long, recumbent and erect, whitish pubescence; femora feebly arcuate, and strongly clavate toward tips; tibiae slender, straight, and subcylindrical.

Length, 8.5 mm.; width, 3.8 mm.

Type locality.—Mayaguez, Porto Rico.

Type.—In American Museum of Natural History. A unique female collected August 12, 1925, by R. H. Van Zwaluwenburg.

Remarks.—Described from the type.

This species is allied to *insularis* Fisher, but it differs from that species in being pale reddish brown, with numerous small, round

asperities on the pronotum, but without very conspicuous pubescent markings on the elytra.

DORCASTA GRACILIS, new species

Elongate, very narrow, subcylindrical, and similar in form to *Hippopsis lemniscatus* Fabricius. Above and beneath brownish black, feebly shining, and the upper surface ornamented with longitudinal, yellowish-white pubescent vittae.

Head in front very long, and inflexed, feebly convex, antennal tubercles approximate at base, and moderately elevated, surface rather densely, coarsely, irregularly punctate, rather densely clothed with moderately long, recumbent, whitish pubescence, with a few long, erect, black setae intermixed, and ornamented on each side behind the eyes with two obsolete, longitudinal, pale yellow, pubescent vittae; eyes very small, round, and feebly emarginate. Antenna as long as the body, robust, uniformly black, densely clothed with short, recumbent pubescence, and rather densely clothed beneath with very long, erect, black hairs; first joint cylindrical, subequal in length to the fourth joint, which is slightly longer than the third, the following joints gradually diminishing in length.

Pronotum cylindrical, slightly longer than wide, and subequal in width at base and apex; sides parallel; disk strongly convex; surface coarsely, rather densely, deeply punctate, sparsely clothed with short, recumbent, inconspicuous pubescence, with numerous long, erect, black setae, and ornamented on each side with two narrow, longitudinal, pale yellow pubescent vittae. Scutellum small, triangular, and broadly rounded at apex.

Elytra four times as long as pronotum, widest at apical fourth, and at base subequal in width to the pronotum; sides feebly diverging from base to apical fourth, then arcuately narrowed to the tips which are conjointly, very deeply, arcuately emarginate, forming a long, acute tooth at lateral angle of each elytron; disk strongly convex; surface vaguely rugose, coarsely, deeply punctate, the punctures arranged in rows and distinctly separated, sparsely clothed with short, recumbent, inconspicuous pubescence, with numerous long, erect, black setae, and each elytron ornamented with two narrow, longitudinal, pale yellow pubescent vittae, alternating with two similar vittae of sparsely placed, whitish hairs.

Abdomen beneath finely, densely punctate, or granulose, and rather densely clothed with long, recumbent, whitish pubescence; last segment broadly subtruncate at apex. Prosternum coarsely, densely punctate, sparsely clothed with recumbent, whitish pubes-

cence; prosternal process rather narrow, and strongly, triangularly expanded behind the coxae. Legs very short; femora robust.

Length, 5.6–8 mm.; width, 1–1.4 mm.

Type locality.—Fourgu, Haiti.

Other locality.—Diquini, Haiti.

Type and paratype.—U.S.N.M. No. 43754.

Paratypes.—In Museum of Comparative Zoology.

Remarks.—Described from six examples (sexes not determined). The type, collected March 12, 1930, by H. L. Dozier; and five paratypes, received from the Museum of Comparative Zoology, collected at Diquini, Haiti, by William M. Mann.

This species resembles *Hippopsis lemniscatus* Fabricius very closely, but it differs from that species in having the antennae robust, not longer than the body, and the upper surface of the body clothed with numerous long, erect, black setae.

LEPTOSTYLUS MILLERI, new species

Strongly robust, and moderately convex above, uniformly dark reddish brown above, slightly paler beneath, rather densely clothed with greenish yellow, scalelike pubescence, and mottled with darker and paler areas; mandibles black; palpi dark brown, with the tips paler.

Head quadrate in front of the antennal tubercles, narrower at top than at bottom, feebly convex, deeply, angularly depressed between the antennal tubercles, which are not very widely separated, but strongly elevated, finely, densely punctate, rather densely, irregularly clothed with short, recumbent, yellowish pubescence, giving the surface a mottled appearance, and with a narrow, longitudinal groove extending from the epistoma to occiput; eyes small, rather coarsely granulated, deeply emarginate, and separated from each other on the top by twice the width of the upper lobe. Antenna slightly longer than the body, mottled with whitish and brownish pubescence, the joints annulated with dark brown at their bases and apices; first joint slender, subcylindrical, gradually expanded toward the apex, extending to middle of pronotum, and subequal in length to the third joint, which is slightly longer than the fourth.

Pronotum three-fourths wider than long, subequal in width at base and apex, and widest at middle; sides nearly parallel, feebly constricted near base and apex, and arcuately tumid on each side at middle; disk uneven, narrowly, transversely depressed near base and apex, and with seven obtusely rounded tubercles, arranged transversely in two rows, the five median ones strongly elevated, of which the two anterior ones are the largest; surface coarsely, irregularly punctate, with a distinct row of deeper punctures in the basal and apical depressions, rather densely clothed with recumbent, brownish

and yellowish pubescence, giving the surface a mottled appearance, the pubescence with a greenish tinge in certain lights. Scutellum broadly triangular, and broadly rounded at apex.

Elytra four times as long as pronotum, and slightly wider than pronotum at middle; humeri strongly developed and elevated; sides nearly parallel from base to apical third, then strongly, arcuately narrowed to the tips, which are separately, narrowly, obliquely truncate; disk uneven, broadly, feebly depressed at basal third, with numerous irregularly distributed tubercles, those on the basal regions more strongly developed; surface coarsely, rather densely, irregularly punctate, the punctures becoming finer and more obsolete toward the apices, rather densely clothed with short, recumbent, pale yellow pubescence, variegated with brownish pubescence, but not forming distinct designs, except for an obsolete, narrow, transverse, zigzag, white fascia on each elytron behind the middle, and the tubercles clothed with dark brown hairs.

Abdomen beneath feebly, finely, densely punctate, and rather densely clothed with short, recumbent, whitish pubescence; last segment elongate, strongly attenuate posteriorly, and arcuately emarginate at apex. Prosternum feebly, arcuately elevated between the coxæ; prosternal process about two-thirds as wide as the coxal cavities. Legs mottled with short, recumbent, whitish pubescence; femora feebly arcuate, and strongly, abruptly clavate toward the apices; tibiae subcylindrical.

Length, 8 mm.; width, 3.6 mm.

Type locality.—Rio San Juan, Dominican Republic.

Type.—U.S.N.M. No. 43755. A unique example (sex not determined) collected in March, 1928, by G. S. Miller, jr.

Remarks.—Described from the type. This species resembles *cristatus* Fisher, but it differs from that species in having the tips of the elytra obliquely truncate, without a basal crest on each elytron, and by the different pubescent markings.

LEIOPUS INFUSCATUS, new species

Elongate, subparallel, and rather strongly flattened above, uniformly brownish yellow, densely clothed with brownish-white, scale-like pubescence, and ornamented with dark-brown pubescent markings; mandibles reddish, with the tips black; palpi brown, with the tips yellow.

Head quadrate in front of antennal tubercles, subequal in width at top and bottom, feebly convex, rather deeply, triangularly depressed between the antennal tubercles, which are rather widely separated and strongly elevated, finely, densely punctate, densely clothed with short, recumbent, brownish and whitish pubescence, giving the surface a mottled appearance, and with a narrow, longitudinal groove

extending from the epistoma to occiput; eyes small, not very coarsely granulated, deeply emarginate, and separated from each other on the top by one and one-half times the width of the upper lobe. Antenna about one and one-half times as long as the body, first four joints mottled with whitish and brownish pubescence, the following joints clothed with whitish pubescence, and annulated with brown at their bases and tips; first joint moderately robust, subcylindrical, gradually expanded toward apex, extending to basal third of pronotum, and slightly shorter than the fourth joint, which is feebly shorter than the third.

Pronotum nearly twice as wide as long, subequal in width at base and apex, and widest at basal third; sides obliquely expanded from apex to basal third, where they are obtusely angulated, then narrowly, strongly, abruptly constricted; disk even, and feebly, narrowly, transversely depressed along the base and apex; surface sparsely, irregularly punctate, with a row of more distinct punctures in the basal and apical depressions, densely clothed with short, recumbent, brownish-yellow and whitish-yellow pubescence, which conceals the surface, and ornamented with dark brown pubescent spots as follows: Two small, round spots arranged transversely in front of middle, and a short, longitudinal vitta in front of scutellum. Scutellum broadly triangular, broadly rounded at apex, and clothed with dark brown pubescence.

Elytra four times as long as pronotum, and distinctly wider than pronotum at basal third; humeri strongly developed and elevated; sides nearly parallel from base to apical third, then strongly arcuately narrowed to the tips, which are separately, narrowly, obliquely truncate; disk slightly uneven, with numerous irregularly arranged asperities; surface rather coarsely, densely punctate, densely clothed with short, recumbent, brownish-yellow and whitish pubescence, which nearly conceals the surface, and each elytron ornamented with dark brown pubescent markings as follows: A more or less distinct vitta extending along the sutural margin from scutellum to apical third, then obliquely outward to the lateral margin at apical fourth (the oblique part more obsolete), a large broad-spot extending along lateral margin from humerus to middle, and with small, round spots on the asperities.

Abdomen beneath feebly, finely, densely punctate, rather densely clothed with moderately short, recumbent, whitish pubescence; last segment strongly attenuate posteriorly, and feebly, arcuately emarginate at apex. Prosternum nearly flat between the coxae; prosternal process about one-third as wide as the coxal cavities. Legs mottled with whitish and yellowish pubescence; femora feebly arcuate, and strongly, abruptly clavate toward the tips; tibiae subcylindrical, and darker toward the tips.

Length, 5.6 mm.; width, 2.2 mm.

Type locality.—Samana, Dominican Republic.

Other locality.—Port au Prince, Haiti.

Type and paratypes.—U.S.N.M. No. 43756.

Remarks.—Described from three examples (sexes not determined): The type and one paratype, collected at the type locality, March 11, 1928, by G. S. Miller, jr.; and one paratype, collected at Port au Prince, Haiti, in 1899, by R. J. Crew.

This species is very closely allied to *variabilis* Fisher, described from Cuba, but it differs from that species in being more brownish in color, the pubescence on the elytra sparser and shorter, and the brown pubescent markings more distinct.

The pubescent markings on the three examples examined show a slight variation; on one of the paratypes the brown vitta is confined to the sutural margins, whereas in the other paratype it is reduced to a small spot on each elytron at apical third.

LEIOPUS DOZIERI, new species

Shorter and more strongly convex above than *poeyi* Fisher, uniformly dark reddish brown, densely clothed with brownish-yellow pubescence, and mottled with whitish and blackish areas; mandibles black; palpi dark brown, with the tips paler.

Head quadrate in front of antennal tubercles, feebly narrower at top than at bottom, flat, broadly concave between the antennal tubercles, which are widely separated and slightly elevated, finely, densely punctate, densely clothed with moderately long, recumbent, brownish-white pubescence, which conceals the surface; eyes small, not very coarsely granulated, deeply emarginate, and separated from each other on the top by twice the width of the upper lobe. Antenna nearly one and one-half times as long as the body, first five joints mottled with whitish and brownish pubescence, the following joints clothed with whitish pubescence, and annulated with brown at their bases and apices; first joint slender, subcylindrical, gradually expanded toward the apex, extending to basal third of pronotum, and subequal in length to the fourth joint, which is slightly shorter than the third.

Pronotum nearly twice as wide as long, subequal in width at base and apex, and widest just behind the middle; sides vaguely constricted at apex, obliquely expanded from apex to behind middle, then narrowly, strongly, abruptly constricted; disk rather even, feebly, narrowly, transversely depressed along apex and base; surface sparsely, irregularly punctate, densely clothed with short, recumbent, whitish and brownish-yellow pubescence, which conceals the surface, and ornamented with dark brown pubescent markings as

follows: Three small spots along apical margin, a short, longitudinal vitta in front of scutellum, and a large spot on each side at basal constriction. Scutellum broadly triangular, and broadly rounded at apex.

Elytra four times as long as pronotum, and slightly wider than pronotum at middle; humeri moderately developed and feebly elevated; sides nearly parallel from base to apical third, then strongly, arcuately narrowed to the tips, which are separately, narrowly rounded, or vaguely, obliquely subtruncate; disk uneven, feebly, obliquely depressed at basal third, longitudinally depressed along sutural margins behind middle, and with numerous irregularly distributed tubercles; surface rather densely, finely punctate, densely clothed with short, recumbent, brownish-yellow and whitish pubescence, which conceals the surface, and each elytron ornamented with a more or less conspicuous, irregular, whitish pubescent spot near middle, and with numerous, irregularly distributed, black pubescent markings on the tubercles and behind the middle.

Abdomen beneath finely, densely punctate, densely clothed with moderately long, recumbent, whitish pubescence; last segment strongly attenuate posteriorly, and broadly subtruncate, or feebly, arcuately emarginate at apex. Prosternum nearly flat between the coxae; prosternal process about one-third as wide as the coxal cavities. Legs mottled with whitish and brownish pubescence; femora feebly arcuate, and strongly, abruptly clavate toward the tips; tibiae subcylindrical, and each annulated with brown pubescence near middle and at apex.

Length, 6.5 mm.; width, 2.8 mm.

Type locality.—Port au Prince, Haiti.

Other locality.—Cape Haitien, Haiti.

Type.—U.S.N.M. No. 43757. Collected at light, March 25, 1930, by H. L. Dozier.

Paratype.—In Museum of Comparative Zoology. Collected at Cape Haitien, Haiti, by William M. Mann.

Remarks.—Described from the type and paratype (sexes not determined).

This species resembles *variabilis* Fisher, but it differs from that species in being shorter and more robust, and without a dark brown pubescent spot on each side of the elytra behind the humerus.

PROBATIUS UNICOLOR, new species

Female.—Broadly elongate, and moderately convex above, uniformly reddish brown, and sparsely, irregularly clothed with whitish pubescence, which has a tendency to form vague, narrow vittae

toward the side of each elytron; mandibles black, more reddish toward bases; palpi brownish yellow.

Head quadrate in front of antennal tubercles, subequal in width at top and bottom, feebly convex, broadly but not deeply depressed between the antennal tubercles, which are widely separated and strongly elevated, finely, densely punctate, rather densely clothed with long, recumbent, whitish pubescence, which nearly conceals the surface, and with a narrow, longitudinal groove extending from epistoma to occiput; eyes large, deeply emarginate, and separated from each other on the top by one and one-half times the width of the upper lobe. Antenna slightly longer than the body (eleventh joint missing), rather densely clothed with short, recumbent, whitish pubescence, with a few long, erect, stiff black hairs intermixed, the joints annulated at bases with denser, white pubescence; first joint slender, subcylindrical, feebly expanded toward apex, extending nearly to base of pronotum, subequal in length to the third joint, which is slightly longer than the fourth.

Pronotum twice as wide as long, subequal in width at base and apex, and widest at middle; sides nearly parallel, feebly sinuate, and with a large, obtuse tubercle on each side just behind the middle; disk moderately convex, rather even, and rather broadly, transversely depressed along base; surface feebly, finely, densely punctate, with a row of coarse punctures along basal depression, and rather densely, irregularly clothed with moderately long, recumbent, whitish pubescence. Scutellum broadly triangular, broadly rounded at apex, and rather densely pubescent.

Elytra four and one-half times as long as pronotum, and at base slightly wider than pronotum at middle; humeri rather strongly developed; sides parallel to just behind the middle, then arcuately narrowed to the tips, which are conjointly, deeply, arcuately emarginate, and acutely produced at lateral margin of each elytron; disk strongly convex, and each elytron vaguely gibbose near base; surface coarsely, deeply, irregularly punctate, the punctures dense in basal regions, but becoming sparser toward apices, sparsely clothed with short, recumbent, whitish pubescence (forming inconspicuous narrow, longitudinal vittae toward the sides), and with numerous long, erect, black setae intermixed.

Abdomen beneath finely, densely punctate, and rather densely clothed with long, recumbent, white pubescence, which nearly conceals the surface; last segment broadly, but not deeply, arcuately emarginate at apex. Prosternal process three-fourths as wide as coxal cavities, and strongly, arcuately declivous in front and behind. Mesosternum broadly triangular between the coxae, abruptly, arcu-

ately declivous in front, and broadly subtruncate posteriorly. Femora feebly arcuate, and strongly clavate toward apices.

Length, 8.5 mm.; width, 4.4 mm.

Type locality.—Furcy, Haiti.

Type.—U.S.N.M. No. 43758. Female, collected by William M. Mann.

Remarks.—Described from the type.

This species is allied to *umbraticus* Jacquelin-Duval, but it differs from that species in being rather uniformly clothed with whitish pubescence, but not forming distinct markings.

CALOCOSMUS MAGNIFICUS, new species

Female.—Elongate, robust, subparallel, above and beneath orange-yellow, except tips of mandibles, antennae, small spot on head, three small spots on pronotum, scutellum, humerus and three spots on each elytron, sides of metasternum and mesosternum, small spot on each side of apical segments of the abdomen, tibiae, and part of the tarsi, which are black.

Head in front strongly transverse, flat between the antennal tubercles, which are very widely separated and feebly elevated, sparsely, coarsely, irregularly punctate, densely clothed with a fine, scalelike, orange-yellow pubescence, with a few long, erect, black hairs intermixed, and with a narrow longitudinal groove extending from epistoma to occiput; eyes large, finely granulated, nearly divided, and separated from each other on the top by six times the width of the upper lobe. Antenna not quite so long as the body, rather robust, uniformly black, densely clothed with short, recumbent, black pubescence, with a few long, erect hairs intermixed; first joint robust, gradually expanded toward apex, subequal in length to the fourth joint, which is two-thirds as long as the third, the following joints gradually diminishing in length.

Pronotum nearly one-half wider than long, slightly narrower at base than at apex, widest at middle; sides nearly parallel, strongly sinuate, obtusely tumid at middle; disk strongly convex, feebly, transversely depressed along base, vaguely tumid in front of scutellum; surface sparsely, coarsely, irregularly punctate, densely clothed with minute, scalelike, orange-yellow pubescence, with a few long, erect, inconspicuous, black hairs intermixed, and ornamented with three small, black spots, one at middle and one on each side near the lateral callosity. Scutellum transversely triangular, broadly rounded at apex.

Elytra three times as long as pronotum, widest at base, distinctly wider than pronotum at middle; humeri strongly developed; sides strongly deflexed anteriorly, feebly narrowed from base to apical

fourth, then arcuately narrowed to the tips, which are conjointly, broadly rounded; disk moderately convex, feebly uneven on basal third; surface finely, sparsely punctate on basal two-thirds, densely clothed with minute, scalelike, orange-yellow pubescence (except on the dark spot, where the pubescence is black, and the spots obsoletely bordered by whitish scalelike pubescence), with a few inconspicuous, erect, black hairs intermixed, and each elytron ornamented with black markings as follows: A small spot at humerus, a small, irregular, transverse spot at basal third, a rather broad, irregular, transverse fascia behind the middle, the fascia extending from lateral margin to near the sutural margin, and strongly constricted at middle and a narrow spot along apical margin.

Abdomen beneath finely, densely punctate, densely clothed with short, recumbent, whitish pubescence; last segment broadly rounded and feebly, angularly emarginate at apex. Prosternum arcuately declivous in front and behind, and narrow between the coxal cavities. Legs rather long; femora robust, subcylindrical, slightly flattened; tibiae slender, slightly enlarged toward the apices.

Length, 13.5 mm.; width, 5.2 mm.

Type locality.—Labeled "Valley Riviere Froide, Haiti."

Type.—U.S.N.M. No. 43759. A unique female collected April 20, 1925, by W. A. Hoffmann.

Remarks.—Described from the type.

This species is allied to *venustus* Chevrolat, but it differs from that species in having the pronotum ornamented with three black spots, each elytron with three black spots and a transverse, constricted, black fascia behind the middle, and the upper surface of the body densely clothed with minute, scalelike pubescence.

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REVISION OF THE NEARCTIC ICHNEUMON-FLIES BELONGING TO THE GENUS *MACROCENTRUS*

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During the past several years species of the braconid genus *Macrocentrus* Curtis have been rather abundantly reared from the larvae of certain injurious Lepidoptera, especially from the introduced oriental fruit moth (*Laspeyresia molesta* Busck) and the European corn borer (*Pyrausta nubilalis* Hübner). The numerous requests for identification of specimens of *Macrocentrus* that have come to the taxonomic unit of the Bureau of Entomology, combined with the difficulties in making such identifications owing to the unworked condition of the group, resulted in a demand for a revision of the species occurring in the United States and Canada. Accordingly, I was requested to undertake a study of *Macrocentrus*, the results of which, presented in this paper, represent a joint contribution from the division of forest insects (gipsy moth and brown-tail moth investigations) and the taxonomic unit of the Bureau of Entomology.

For the opportunity of examining material in their custody I am indebted to Dr. E. T. Cresson, jr., of the Philadelphia Academy of Natural Sciences; to C. W. Johnson, of the Boston Society of Natural History; and Dr. W. E. Britton, of the Connecticut Agricultural Experiment Station. I wish also to acknowledge my appreciation of helpful suggestions given by A. B. Gahan and R. A. Cushman, of the taxonomic staff of the Bureau of Entomology. Finally, I am indebted to C. W. Collins, in charge of the gipsy moth and brown-tail moth investigations of the division of forest insects, and to Dr. Harold Morrison, in charge of the taxonomic unit, whose cooperation has made the study possible.

Although, as noted above, certain material in other institutions has been examined, the present revision is based primarily on the collections of *Macrocentrus* in the United States National Museum, which consist in large part of specimens reared in the Bureau of Entomology in the course of studies relating to the life history and

control of various injurious species of Lepidoptera. The types of most of the previously described species of *Macrocentrus* have been examined. I have not, however, seen the type of *nigridorsis* Viereck, which is in the Canadian National Collection at Ottawa; that of *iridescens* French, the location of which is unknown to me; or those of the four species described by Provancher, namely, *uniformis*, *pectoralis*, *mellipes*, and *longicornis*, which are in the Museum of Public Instruction at Quebec, although notes made several years ago by S. A. Rohwer on the types of the Provancher species have aided materially in the identification of some of these. It has been found impossible to identify *nigridorsis*, *iridescens*, and *pectoralis* with certainty, but the apparent position and relationships of each of these will be discussed.

Owing to the little taxonomic attention that has been given this genus in recent years, it has become necessary to describe 20 new species in connection with this revision. The types of 19 of these are in the United States National Museum, while that of one species is in the collection of the Boston Society of Natural History.

Family BRACONIDAE

Subfamily MACROCENTRINAE

Genus MACROCENTRUS Curtis

- Macrocentrus* CURTIS, Ent. Mag., vol. 1, p. 187, 1833. (Genotype, *Macrocentrus bicolor* Curtis=*Macrocentrus thoracicus* (Nees).)
Amicroplus FOERSTER, Verh. naturh. Ver. preuss. Rheinlands, vol. 19, p. 256, 1862. (Genotype, *Rogas collaris* (Spinola) Nees.)
Phogra CAMERON, Trans. New Zealand Inst., vol. 33, p. 104, 1901. (Genotype, *Phogra rubromaculata* Cameron.) (New synonymy.)
Dolichozele VIERECK, Proc. U. S. Nat. Mus., vol. 40, p. 182, 1911. (Genotype, *Dolichozele koebelei* Viereck.) (New synonymy.)
Metapleurodon ENDERLEIN, Arch. Naturg., vol. 84A, pt. 11, p. 213, 1920. (Genotype, *Metapleurodon ceylonicus* Enderlein.) (New synonymy.)
Paniscozele ENDERLEIN, Arch. Naturg., vol. 84A, pt. 11, p. 214, 1920. (Genotype, *Paniscozele sumatrana* Enderlein.) (New synonymy.)

Most workers in the Braconidae have recognized the close relationship between *Macrocentrus* and *Zeles*, and since the publication of Foerster's classification¹ in 1862 the two genera have constituted the basis of a distinct major division of the Braconidae. Ashmead² divided his subfamily Macrocentrinae, which corresponds to the Macrocentroidae of Foerster and the Macrocentrides of Marshall,³ into two tribes, the Macrocentrini and the Zelini, with *Macrocentrus* and *Zeles*, respectively, the typical genera. And although they

¹ Verh. naturh. Ver. preuss. Rheinlands, vol. 19, p. 256, 1862.

² Proc. U. S. Nat. Mus., vol. 23, p. 118, 1900.

³ Trans. Ent. Soc. London, 1885, p. 10.

are obviously closely related, the two groups exhibit well-defined differences, which under some systems of classification may be considered of tribal value. *Macrocentrus* has the occiput entirely immargined, eyes not at all emarginate, first segment of flagellum nearly always much longer than the scape, pronotum medially above flat and always without anteriorly converging keels, the insertion of the abdomen entirely above the upper level of the insertion of the posterior coxae, the medius always more or less curved backward near the middle, trochanters usually armed with short teeth at apex on the outer side, longer calcarium of posterior tibia rarely more than half as long as basitarsus, and the ovipositor usually long. *Zelee*, on the other hand, has the occiput distinctly margined, eyes slightly emarginate, first flagellar segment usually no longer than scape, the dorsum of pronotum always with two prominent keels medially that converge anteriorly and set off a small triangular area just in front of the prescutum, the insertion of the abdomen not completely above the upper level of the insertion of hind coxae, medius straight, not at all curved backward near the middle, trochanters always without the apical teeth usually found in *Macrocentrus*, longer calcarium of posterior tibia always more than half as long as basitarsus, and the ovipositor always very short.

In addition to *Macrocentrus* Ashmead included in his tribe Macrocentrini the following genera: *Dicranoneura* Kriechbaumer, which was proposed for an African species and apparently does not occur in North America; *Microtypus* Ratzeburg, which is more closely related to the Blacinae than to the Macrocentrinae and should be definitely excluded from the latter group;⁴ *Amicoplidea* Ashmead, based upon *Phylax palliventris* Provancher, which appears from the original description, and from notes made by S. A. Rohwer on an examination of the type in 1915, to be an exothecine rather than a macrocentrine; and *Amicroplus* Foerster, which, as indicated by Lyle,⁵ must be synonymized with *Macrocentrus*.

In 1920 Enderlein erected *Paniscozele* for a group of seven new species from the Oriental, Ethiopian, and Neotropical regions. Viereck in 1911, however, had proposed *Dolichozele* for a South American species, which is clearly congeneric. Several years ago I had the opportunity of examining the genotype of *Paniscozele*, which is in the Pomeranian Museum of Natural History at Stettin, and a comparison of my notes on *P. sumatrana* Enderlein with the genotype of *Dolichozele*, which is in the United States National Museum, has shown conclusively that *Paniscozele* must be sup-

⁴ Szepligeti, Ann. Mus. Nat. Hungarici, vol. 6, p. 426, 1908, has proposed the subfamily Microtypinae for this genus.

⁵ Entomologist, vol. 47, p. 257, 1914.

pressed as a synonym of *Dolichozele*. And the latter name, in my opinion, must in turn fall as a synonym of *Macrocentrus*. Apart from the very short ovipositor, the long calcaria of the posterior tibiae, and the long acute metapleural tooth, *Dolichozele* does not differ from normal *Macrocentrus*, and these differences are apparently only comparative. *Paniscozele atreitarsis*, one of Enderlein's originally included species, was described as having an ovipositor nearly as long as the body; while the metapleural tooth, though usually less prominent and acute, occurs in nearly all species of *Macrocentrus*, and the long tibial calcaria are found in some. Accordingly, since it has seemed impossible to distinguish clearly between *Dolichozele* and *Macrocentrus*, I have placed the former, and its synonym *Paniscozele*, in synonymy under *Macrocentrus*.

I have also seen the type of *Fhogra rubromaculata* Cameron, which is in the British Museum, and that of *Metapleurodon ceylonicus* Enderlein, which is in the Pomeranian Museum of Natural History, the genotypic species, respectively, of *Fhogra* Cameron and *Metapleurodon* Enderlein. In my opinion both belong in *Macrocentrus*.

Apparently all species of *Macrocentrus* are internal parasites of lepidopterous larvae, and at least in most cases the host larvae live more or less concealed, principally as leaf rollers or as borers. Most of the species seem to be solitary parasites, but some are gregarious, and in the case of the latter type it has been frequently observed that all adults obtained from a single group of cocoons are usually of one sex. This naturally has suggested the probable occurrence of polyembryony, and recently Parker⁶ has shown that this method of reproduction does occur in *Macrocentrus gifuensis* Ashmead, a gregarious parasite of the European corn borer (*Pyrausta nubilalis* Hübner). No doubt it is common to many species of the genus.

Species of *Macrocentrus* appear to be rather less specific in host selection than those of many other groups of Braconidae, and the same host species may be attacked by several different forms. Four species of *Macrocentrus*, for example, are known to parasitize the larvae of *Laspeyresia molesta* Busck, the introduced oriental fruit moth; while 9 different host species have been recorded for *M. ancylivorus* and 12 for *M. delicatus*. A list of the hosts of *Macrocentrus* recorded in this paper is given on pages 53-54.

Owing to the extent of variation occurring within species, it has seemed desirable to make the key rather full and to give detailed descriptions of the species.

⁶ U. S. Dept. Agr. Tech. Bull. 230, 63 pp., illus., 1931.

KEY TO THE NEARCTIC SPECIES OF MACROCENTRUS¹

1. Maxillary palpi short, not distinctly longer than height of head; labial palpi very short, shorter than the face, even the apical segment but little longer than thick; antennae 24 to 40 segmented; head always black; small species, normally measuring 3 to 4.5 mm. in length..... 2
- Maxillary palpi usually much longer than height of head; very rarely not distinctly so, but then head is not black; labial palpi rarely shorter than face, the apical segment usually three or more times as long as thick; antennae normally 40 to 60 segmented..... 5
2. Second intercubitus lacking; nervellus inclivous, much longer than lower abscissa of basella, the latter hardly one-fourth as long as mediella; antennae 24 to 30 segmented; ovipositor sheaths a little longer than abdomen, but much shorter than body; thorax and abdomen mostly piceous or blackish, with prothorax and mesothorax paler..... 1. *incompletus*, new species
- Second intercubitus distinct though often hyaline; nervellus at least no longer than lower abscissa of basella, the latter less than one-third mediella; antennae usually 30 to 40 segmented; ovipositor sheaths at least as long as the body..... 3
3. Legs short and rather stout; anterior basitarsus not distinctly half as long as anterior tibia; apical segment of anterior tarsus as long as the second; longer calcarium of posterior tibia half as long as basitarsus; antennae distinctly shorter than the body, second flagellar segment only twice as long as thick; thorax and abdomen black..... 2. *crassipes*, new species
- Legs very slender; anterior basitarsus more than half as long as anterior tibia; apical segment of anterior tarsus much shorter than the second; longer calcarium of posterior tibia much less than half as long as basitarsus; antennae longer than the body, second flagellar segment more than three times as long as thick; thorax and abdomen usually more or less yellowish..... 4
4. Eyes small; cheeks broad and strongly convex in both sexes; female antennae normally 32 to 35 segmented, flagellum mostly brownish piceous except three or four basal segments, which are yellowish; male thorax more or less blackish or piceous, mesonotum and sometimes entire thorax blackish.
3. *crambivorus* Viereck
- Eyes not especially small; cheeks gradually receding; female antennae normally 37 to 39 segmented, flagellum yellowish with apical half somewhat fuscous; thorax in both sexes yellow, with pronotum and propodeum dusky or blackish.
4. *crambi* (Ashmead)

¹In the key, as well as in the descriptions and discussions that follow, much use has been made of venational differences. The terminology employed is that proposed by Rohwer and Gahan, *Horismology of the hymenopterous wing*, Proc. Ent. Soc. Washington, vol. 18, pp. 20-76, 1916.

5. Submedian cell always closely hairy, never glabrous at apex; apical teeth of trochanters, especially of anterior legs, very weak, indistinct; mediella not, or hardly, more than twice as long as lower abscissa of basella, the latter longer than nervellus, usually much longer; scutellum usually not distinctly half the median length of propodeum; stigma never uniformly pale yellow; small, slender species that are apparently all gregarious parasites..... 6
- Submedian cell weakly hairy apically, usually with a distinct hairless area at apex, rarely uniformly hairy, but then mediella about three times as long as lower abscissa of basella with the latter not longer than nervellus, and the apical teeth of trochanters distinct, or the stigma uniformly pale yellow; scutellum usually more than half the median length of propodeum; apparently all solitary parasites..... 13
6. Head entirely black; face broader, usually much broader, than long to base of clypeus; ocell-ocular line twice as long as diameter of a lateral ocellus; thorax varying from entirely black to entirely yellow, but usually at least pronotum more or less dusky or blackish..... 7
- Head varying from yellow to mostly black, the face never entirely black, at most reddish brown, blackish above and medially, and then face not distinctly broader than long to base of clypeus and ocell-ocular line distinctly less than twice the diameter of a lateral ocellus; at least pronotum and venter of thorax pale, even in the darkest specimens..... 12
7. Metapleurum completely rugulose and subopaque; mesopleurum below and anteriorly as well as prepectus usually punctat rugulose; face nearly twice as broad as long to clypeus; malar space about as long as clypeus; three basal abdominal tergites testaceous, thorax usually black or blackish, with metanotum and propodeum often ferruginous.... 5. *terminalis* (Ashmead)
- Metapleurum smooth at least basally; basal abdominal tergites usually black or blackish; otherwise not combining all the above characters..... 8
8. First, second, and more or less of third abdominal tergites closely longitudinally aciculate; nervulus distinctly a little postfurcal; stigma usually without a distinct pale spot at base; ovipositor sheaths at least as long as the body..... 9
- Only the first and second abdominal tergites sculptured and the second usually smooth apically; nervulus interstitial; stigma brown with a conspicuous yellow spot at base; ovipositor sheaths not longer than abdomen..... 6. *longicornis* Provancher
9. Radial cell unusually short, measured on wing margin only a little longer than stigma and about one and one-half times as long as its greatest width; nervellus nearly as long as lower abscissa of basella; abdomen entirely black or blackish above and below; posterior tibiae black except at base; all tarsi blackish..... 7. *peroneae*, new species
- Radial cell normal, about twice as long, measured on wing margin, as its greatest width; nervellus much shorter than lower abscissa of basella; three basal abdominal sternites usually pale; usually more or less of third tergite, sometimes more or less of the three basal tergites, reddish yellow..... 10

10. Malar space about as long as clypeus; level of lower eye margins not distinctly below base of clypeus; dorsum of abdomen entirely black except sometimes on apex of third tergite; thorax black..... 8. *harrisi* De Gant
- Malar space much shorter than clypeus; level of lower eye margins distinctly below base of clypeus; abdomen with at least most of the third tergite, often with more or less of first and second tergites also, testaceous; thorax varying from entirely black to entirely testaceous..... 11
11. Thorax entirely black or piceous; mandibles crossing at tips..... 9. *pyraustae* Viereck
- Thorax varying from entirely testaceous to mostly blackish; at least the venter of thorax, and nearly always the prescutum, yellowish; mandibles barely meeting at tips, the teeth unusually short..... 10. *gifuensis* Ashmead
12. Stigma brown with a large pale spot at base, the apex also narrowly, and usually the anterior margin, pale; nervulus distinctly a little postfurcal; mandibles strongly crossing at tips, the teeth well developed..... 11. *amicroploides* Viereck
- Stigma entirely brown; nervulus interstitial; mandibles very short, hardly meeting at tips, the teeth very short.
12. *crocidophorae*, new species
13. First abdominal tergite more or less distinctly impressed or excavated medially at base in front of spiracles; spiracles of first tergite usually farther from each other than from base of tergite; stigma variable; longer calcarium of posterior tibia never more than half as long as metatarsus..... 14
- First abdominal tergite not impressed or excavated medially at base in front of spiracles; spiracles near end of basal third and farther from base of tergite than from each other; occasionally in *uniformis* the first tergite faintly, very shallowly, impressed at base, but then longer calcarium of posterior tibia much more than half as long as basitarsus; stigma long, lanceolate, always entirely yellow, with radius arising from beyond its middle..... 33
14. Extreme length of first discoidal cell not, or scarcely, greater than that of first cubital; second abscissa of cubitus more, usually much more, than half as long as recurrent vein; basella usually interstitial with transverse abscissa of subcostella; radius arising from well beyond middle of stigma..... 26
- Extreme length of first discoidal cell much greater than that of first cubital; second abscissa of cubitus not more, usually much less, than half as long as recurrent vein; basella very rarely interstitial with transverse abscissa of subcostella..... 15
15. Lower abscissa of basella half, or more than half, as long as mediella and distinctly longer than nervellus; face conspicuously impressed medially above; longest segment of maxillary palpus much longer than second segment of antennal flagellum; stigma unicolorous, yellow or brown, radius arising from much beyond its middle; radial cell ending considerably before wing apex..... 16
- Lower abscissa of basella much less than half as long as mediella and not distinctly longer than nervellus; otherwise not combining the above characters..... 17

16. Head and abdomen black; thorax black above; stigma brown; antennae, including scape, blackish----- 13. *atratus*, new species
 Head, thorax, and abdomen uniformly yellow; stigma entirely yellow----- 14. *impressus*, new species
17. Metapleurum completely punctato-rugulose; propodeum strongly rugoso-reticulate; lower part of mesopleurum depressed and confluent punctate; prepectus sculptured; first tergite about three times as long as wide at apex, ruguloso-striate, the spiracles situated beyond basal fourth of tergite; posterior femora longer than their coxae and trochanters combined.
 15. *reticulatus*, new species
 Metapleurum mostly smooth; propodeum finely, usually more or less transversely, sculptured; posterior femora not longer than their coxae and trochanters combined----- 18
18. Apex of radial cell much before wing apex; metacarpus extending length of second intercubitus beyond apex of radial cell; stigma brown, with a conspicuous pale spot at base; nervulus postfurcal by not more than half its length; third abdominal tergite mostly aciculate, the lateral depressed margins of second tergite not wider at base than at middle of tergite----- 19
 Radial cell more nearly attaining apex of wing; metacarpus not extending conspicuously beyond apex of radial cell; color of stigma, origin of nervulus, and sculpture of third abdominal tergite not combined as above----- 20
19. Antennae normally 45 to 50 segmented; nervellus distinctly a little longer than lower abscissa of basella, the latter but little longer than upper abscissa of basella; spiracles of first tergite usually before end of basal fourth of tergite; length usually 4.5 to 5 mm----- 16. *canarsiae*, new species
 Antennae normally 52 to 54 segmented; nervellus not distinctly longer than lower abscissa of basella, the latter nearly twice the upper abscissa; spiracles of first tergite usually distinctly a little beyond basal fourth of tergite; length usually 6.5 to 7 mm----- 17. *insularis*, new species
20. Clypeus very weakly convex and unusually broad, broader than length of second segment of antennal flagellum; distance between clypeal foveae fully as long as face; mandibles large, stout; eyes not prominent, extending but little beyond outer margins of temples; face nearly twice as broad as long to base of clypeus----- 18. *clypeatus*, new species
 Clypeus normal, convex, much narrower than length of second flagellar segment; interfoveal line shorter; eyes prominent; face much less than twice as broad as long----- 21
21. Maxillary palpus with longest segment not distinctly longer than second segment of antennal flagellum; stigma brown with a conspicuous pale spot at base, or yellow with a distinct cloud in apical half; nervulus never postfurcal by as much as its length; abdomen varying from entirely testaceous to more or less blackish at base and apex, but second and third tergites always entirely pale; second tergite not distinctly longer than broad at apex, usually smooth apically; male scape not swollen----- 22

Maxillary palpus with longest segment usually longer than second segment of antennal flagellum; stigma most frequently uniformly brown or yellow; nervulus usually postfurcal by about its own length; usually second and third tergites more or less blackish as well as the first and sometimes the following in part; second tergite most frequently longer than broad and usually completely aciculate; male scape swollen..... 24

22. First abdominal tergite unusually stout, usually not more than one and one-half times as long as broad at apex; distance between spiracles of first tergite at least half the basal width of propodeum; antennae normally 50 to 54 segmented; clypeus about as broad as length of scape and broadly strongly emarginate at apex..... 19. *robustus*, new species

First tergite not especially stout, usually twice as long as broad at apex; distance between spiracles of first tergite much less than half the basal width of propodeum; antennae normally 42 to 48 segmented; clypeus not so broad as length of scape..... 23

23. Mesonotal lobes, and mesosternum posteriorly, black; second abdominal tergite usually completely finely aciculate, the third more weakly so on basal half; ocell-ocular line twice as long as diameter of a lateral ocellus; mesopleurum closely punctate and subopaque below..... 20. *nigripictus*, new species

Mesonotal lobes and mesosternum never black; second abdominal tergite usually smooth apically, the third rarely with distinct aciculations; ocell-ocular line not twice the diameter of a median ocellus; mesopleurum smooth and shining.

21. *ancylivorus* Rohwer

24. Face, viewed from in front, only very little, often indistinctly, broader than long; antennae usually 45 to 50 segmented; stigma usually uniformly brown, occasionally entirely pale yellow; mesoscutum posteriorly sharply emarginate, the scutellar furrow scarcely transverse; dorsum of thorax and abdomen most frequently largely blackish or piceous, though rarely almost entirely yellow; length normally 4 to 5 mm.

22. *instabilis*, new species

Face much broader than long; antennae usually more than 50-segmented; mesoscutum not so sharply emarginate at apex, the scutellar furrow strongly transverse; length usually 6 to 7.5 mm..... 25

25. Second abdominal tergite completely aciculate and usually distinctly longer than broad at apex, the depressed lateral margins not much broadened at base of tergite; third tergite aciculate on basal half; prescutum prominently elevated, descending almost vertically in front; head thin, cheeks not wider than temples, as viewed from side; rather uniformly yellowish ferruginous, mesonotal lobes not blackish.

23. *utilis*, new species

Second abdominal tergite usually mostly smooth apically and usually hardly as long as broad at apex, the depressed lateral margins much broadened at base of tergite; third tergite usually not, or only indistinctly, aciculate; prescutum not strongly convex, descending more gradually in front; cheeks

a little wider than temples; mesonotal lobes nearly always more or less black or dusky medially; metanotum, propodeum, and basal abdominal tergites usually more or less blackish.

24. *laspeyresiae*, new species
26. Head, thorax and abdomen black, the lower part of pleura and the mesosternum sometimes ferruginous..... 27
 Ferruginous or testaceous, often varied with black; abdomen very rarely entirely black, and then head and thorax ferruginous..... 28
27. Legs, including posterior tibiae, honey-yellow; third abdominal tergite completely smooth; nervulus postfurcal by more than half its length..... 25. *mellipes* Provancher
 Posterior tibiae black, pale only at base; third abdominal tergite usually distinctly finely aciculate on basal half; nervulus usually postfurcal by less than half its length..... 26. *aegeriae* Rohwer
28. First and second abdominal tergites incompletely aciculate, the second only weakly so at base; third tergite entirely smooth; second suture indistinct, the second and third tergites not, or indistinctly, separated; radiella not sinuate, the radiellian cell not broadening from middle to apex; wings clear hyaline, with no suggestion of duskiness; posterior coxae completely polished, with no transverse aciculation or lineolation..... 29
 First, second, and most of third, tergites longitudinally aciculate; second and third tergites separated by a fine but distinct suture; radiella more or less sinuate, the radiellian cell broadening a little from middle to apex; wings often a little dusky; posterior coxae usually delicately transversely aciculate or lineolate toward apex..... 31
29. Eyes rather small, not prominent, not or scarcely extending beyond outer margins of temples; clypeus short and broad, nearly flat; face nearly twice as broad as long to base of clypeus; mesopleura and metapleura impunctate.
 Eyes large, prominent, extending much beyond outer margins of temples; clypeus strongly convex; face only a little broader than long; mesopleura and metapleura uniformly punctate..... 30
27. *pulchripennis*, new species
30. Abdomen entirely black, including sternites; legs infuscated; hind tibiae black..... 28. *seminiger*, new species
 Abdomen brownish ferruginous, black at apex; legs testaceous, including hind tibiae..... 29. *affinis*, new species
31. Abdomen short, not distinctly longer than head and thorax combined; eyes very small, not prominent; face about twice as broad as long to base of clypeus; interfoveal line of clypeus hardly as long as foveo-ocular line..... 30. *fuscipennis*, new species
 Abdomen more elongate, distinctly longer than head and thorax combined; eyes prominent, extending much beyond outer margins of temples; face much less than twice as broad as long; interfoveal line longer than foveo-ocular line..... 32

32. Antennae normally 44 to 50 segmented; longest segment of maxillary palpus usually shorter than second segment of antennal flagellum; nervulus usually interstitial; stigma usually brown, paler at base; palpi and tarsi usually more or less fuscous or blackish; head varying from entirely testaceous to entirely black, more or less of occiput and vertex usually blackish; thorax varying from entirely yellow to mostly black; apex of abdomen often black----- 31. *pallisteri* De Gant
- Antennae normally 50 to 55 segmented; longest segment of maxillary palpus at least as long as second flagellar segment of antenna, usually longer; nervulus usually a little postfurcal; stigma uniformly yellow or yellowish ferruginous; palpi and tarsi pale yellow; head, thorax, and abdomen entirely ferruginous or testaceous, without blackish markings.
32. *cerasivoranae* Viereck
33. First, second, and more or less of third abdominal tergites closely longitudinally aciculate or delicately ruguloso-aciculate; longer calcarium of posterior tibia never more than half as long as basitarsus, usually distinctly less; metapleural tooth rounded or truncate; second abscissa of cubitus most frequently less than half as long as recurrent vein; vertex either entirely yellow or with a blackish transverse band----- 34
- Three basal abdominal tergites mostly smooth; longer calcarium of posterior tibia distinctly more than half as long as basitarsus; metapleural tooth acute, very prominent; second abscissa of cubitus much more than half as long, sometimes fully as long, as recurrent vein; vertex always with a broad blackish transverse band extending to the eyes----- 35
34. First abdominal tergite not distinctly three times as long as broad at apex; second tergite only a little, or not, longer than broad; third not longer than broad; nervulus postfurcal by nearly, or quite, its own length; radiellian cell widening slightly at apex; head, including vertex, entirely pale----- 33. *delicatus* Cresson
- First abdominal tergite very slender, more than three times as long as broad at apex; second tergite about twice as long as broad; third much longer than broad; nervulus only slightly postfurcal; radiellian cell not widening at apex; vertex with a broad blackish transverse band extending to the eyes, or nearly----- 34. *nuperus* Cresson
35. Ovipositor sheaths as long as the body; eyes large, very prominent, not divergent below; temples and cheeks strongly receding; longest segment of maxillary palpus hardly as long as first segment of antennal flagellum; first abdominal tergite narrowing from spiracles to base; radiella only weakly sinuate; nervulus postfurcal by more than half its length.
35. *texanus*, new species
- Ovipositor sheaths shorter than height of apical truncature of abdomen; eyes a little divergent below; temples and cheeks rather full, convex; longest segment of maxillary palpus distinctly longer than first segment of antennal flagellum; first abdominal tergite not narrowing from spiracles to base, the spiracles very prominent; radiella strongly sinuate, radiellian cell very narrow at middle; nervulus usually only very weakly postfurcal----- 36. *uniformis* Provancher

1. *MACROCENTRUS INCOMPLETUS*, new species

In the short maxillary palpi, the unusually short and broad face, the strongly convex vertex, the broad temples and cheeks, the non-prominent eyes, and the absence of distinct teeth on the outer apical margins of the trochanters, this species most closely resembles *crassipes*, but it is at once distinguished from all other known North American species of *Macrocentrus* by the absence of the second intercubitus, the strongly inclivous nervellus, the unusually short lower abscissa of basella, and the small number of segments in the antennae; from *crassipes* it differs further in having very slender legs and in the much smoother thorax and abdomen.

Female.—Length 3.5 mm. Head less transverse than is usual in *Macrocentrus*, the temples conspicuously broad and bulging; eyes small and not extending beyond the outer limits of the temples, but situated low so that malar space is short and the vertex broad and strongly convex; face more than twice as broad as long; mandibles long; clypeus fully three times as broad at apex as long, the anterior margin truncate; interfoveal line twice the length of clypeus; maxillary palpi scarcely as long as height of head, the longest segment much shorter than the scape; face, clypeus, frons, temples, and cheeks smooth and polished; ocelli small, ocell-ocular line nearly three times the diameter of an ocellus; antennae very nearly as long as the body, 27-segmented in type.

Thorax rather stout; middle lobe of mesoscutum elevated a little above the level of lateral lobes; mesopleura polished; metapleura smooth; propodeum mostly smooth, weakly roughened down the middle and at apex; legs very slender; trochanters without teeth outwardly at apex; longer calcarium of posterior tibia less than one-third the basitarsus; anterior wing with second intercubitus wanting; the radius usually not distinctly divided into three abscissae; first discoidal cell much longer than first cubital; veins in apical third of wing faint; nervulus very weakly postfurcal; submedian cell closely hairy; posterior wing with nervellus strongly inclivous, usually about twice as long as lower abscissa of basella, the latter hardly one-fourth the mediella; radiella faint.

Abdomen as long as head and thorax combined, somewhat compressed at apex, smooth and polished, with only very faint suggestion of sculpture on first tergite; first tergite more than twice as long as broad at apex; ovipositor sheaths longer than the abdomen but distinctly shorter than the thorax and abdomen combined.

Head black; clypeus, and the mandibles except at apex, ferruginous; antennae piceous to blackish; thorax yellow-ferruginous, with the metanotum, propodeum, and more or less of the pleura piceous to blackish; abdomen piceous, blackish at apex; legs entirely testa-

ceous; wings whitish hyaline, veins and stigma brownish, the latter with a pale yellow spot at base.

Male.—Essentially as in the female except that antennae are a little more slender at apex and the legs a little tinged with piceous; antennae of allotype 28-segmented.

Type.—U.S.N.M. No. 43489.

Type locality.—Garden City, Kans.

Host.—"Cutworm larva."

Remarks.—Described from two females and one male reared May 8, 1914, by F. B. Milliken in the Bureau of Entomology under Chittenden No. 2508, and four females collected on wheat at Guymon, Okla., April 24, 1930, by W. E. Jackson and C. F. Stiles. The National Museum has 20 additional specimens, which are not included in the type series, from Colorado (C. F. Baker collection), one from Wellington, Kans. (E. G. Kelly), and one from McCook, Nebr. This material shows the number of segments in the antennae to range from 25 to 30; there is also considerable variation in the extent of the piceous coloring of the thorax, but the pronotum and mesoscutum are usually somewhat paler than the remainder of the thorax.

2. MACROCENTRUS CRASSIPES, new species

Exceedingly similar to the European *infirmus* (Nees), as represented by two specimens so determined in the United States National Museum, but apparently differing in the longer calcaria of posterior tibiae, in the slightly more transverse head, and in the nervellus being perpendicular to the mediella. It is possible that the two are identical, but with so little material of either form available I am unable definitely to identify as *infirmus* the species here described.

Female.—Length 4.5 mm. Head only a little wider than thorax, vertically short, the face between antennal foramina and clypeus much less than half as long as broad; temples and cheeks rounded, broad; clypeus strongly convex, elevated anteriorly; interfoveal line about equal to foveo-ocular line; eyes small, broadly oval, not extending beyond the outer line of the temples, and situated low so that vertex is very broad and strongly convex, rising much above the level of upper margins of the eyes; ocelli very small; postocellar line more than twice, the ocell-ocular line more than four times, the diameter of an ocellus; maxillary palpi short, not longer than height of head, the longest segment shorter than the scape; labial palpi very short, the apical segments but very little longer than broad; face a little punctate medially; antennae distinctly shorter than the body, 33-segmented, the second segment of flagellum only twice as long as broad; scape short and stout.

Thorax with middle lobe of mesoscutum not rising distinctly above level of lateral lobes; notauli distinctly foveolate only posteriorly; propodeum completely rugulose and opaque; sides of pronotum mostly rugulose; mesopleura confluent punctate below; metapleura mostly punctato-rugulose; legs shorter and stouter than is usual in *Macrocentrus*; all femora short and somewhat thickened; anterior metatarsus not distinctly half the anterior tibia; apical segment of anterior tarsus as long as the second; calcarium of anterior tibia about half the metatarsus; longer calcarium of posterior tibia half the posterior metatarsus; trochanters without distinct teeth outwardly at apex; stigma emitting radius from slightly beyond its middle; radial cell short, ending much before wing apex; first discoidal cell much longer than first cubital; nervulus almost interstitial; submedian cell closely hairy apically; mediella slightly more than twice the lower abscissa of basella, the latter longer than nervellus; radiellian cell not widening apically.

Abdomen slightly longer than head and thorax combined, weakly compressed apically; first tergite about twice as long as wide at apex, impressed at base, delicately ruguloso-aciculate longitudinally, with a distinct though shallowly impressed line down the middle; second tergite about as long as broad at apex, finely longitudinally aciculate on basal half, polished on apical half; remainder of dorsum of abdomen smooth and polished; ovipositor sheaths slightly longer than the body.

Head black; mandibles except tips testaceous; palpi a little dusky; antennae brownish yellow on basal half, blackish apically; thorax entirely black; legs uniformly honey-yellow; wings with a faint dusky tinge; veins and stigma brown, the latter pale at base; abdomen black; ovipositor sheaths brown.

Male.—Agrees with the female except for the usual sexual differences. The antennae of the allotype are 38-segmented and are blackish.

Type.—U.S.N.M. No. 43490.

Type locality.—Lake Placid, N. Y.

Remarks.—Described from one female and one male collected August 15, 1896. There are four additional specimens in the United States National Museum not included in the type series, labeled "Chelsea, Vt., 14-VII-15, H. E. Smith, collector, W. Springfield No. 915525," and two recorded as reared from *Hadena devastatrix* Brace, at Bozeman, Mont., August 5, 1909. These six are considerably smaller than the types but otherwise appear to be indistinguishable.

3. MACROCENTRUS CRAMBIVORUS Viereck

Macrocentrus (*Amicroplus*) *crambivorus* VIERECK, Proc. U. S. Nat. Mus., vol. 40, p. 183, 1911.

Macrocentrus (*Amicroplus*) *plesius* VIERECK, Proc. U. S. Nat. Mus., vol. 44, p. 556, 1913. (New synonymy.)

Types.—In the United States National Museum.

In his description of *plesius*, Viereck called attention to the similarity of that species to *crambivorus*, but apparently he did not appreciate the extent to which variation occurs in species of *Macrocentrus*. In my opinion the types of the two species are clearly conspecific, and it may become necessary to suppress both names as synonyms of *crambi* Ashmead, but owing to the apparent constancy of certain differences *crambivorus* is for the present being held distinct. The eyes in general are smaller than in *crambi*, and the cheeks and temples correspondingly broader and less strongly receding, the malar space longer, and the face slightly broader; the female antennae appear constantly to have fewer segments, as noted in the key, and to be a little darker in color; the male antennae are similar in the two species, being usually 36 to 39 segmented with the flagellum entirely brown, but the thorax of males of *crambivorus* seems to be consistently darker in color than in *crambi*; in general the lower abscissa of basella, as compared with the upper abscissa, is relatively longer in *crambivorus*, but this difference is not dependable.

The material examined includes, in addition to the type series of *crambivorus* and *plesius*, series in the national collections reared from crambid larvae taken at Mount Jackson, Va., and Elmore, Ohio; three specimens obtained from *Crambus hortuellus* Hübner at Wareham, Mass.; another series reared from a *Crambus* larva on corn, locality not noted; and collected specimens from Virginia, Massachusetts, Pennsylvania, District of Columbia, Georgia, Illinois, Iowa, South Dakota, Colorado, and Canada; also a single specimen from Michigan at the corn-borer laboratory, at Arlington, Mass.; and a series of 12 specimens from Marthas Vineyard, Mass., in the collection of the Boston Society of Natural History.

4. MACROCENTRUS CRAMBI (Ashmead)

Amicroplus *crambi* ASHMEAD, Journ. Cincinnati Soc. Nat. Hist., vol. 17, p. 48, 1894.

Type.—In the United States National Museum.

The close relationship between this species and *crambivorus* has been discussed above under the latter name. *M. crambii* is also somewhat similar to *collaris* (Spinola) Nees, which was designated by Foerster as the type of his genus *Amicroplus*, but differs in its more slender form, smaller head, and much longer ovipositor.

In addition to the type, which is a male from Indiana reared from *Crambus zeellus* Fernald, the United States National Museum has specimens from Virginia, Tennessee, Indiana, and Pennsylvania, as well as some without locality data. Hosts recorded for specimens among this material include *Crambus mustabilis* Clemens, *C. trisectus* Walker, and *C. zeellus* Fernald.

5. **MACROCENTRUS TERMINALIS** (Ashmead), new combination

Zele terminalis ASHMEAD, Proc. U. S. Nat. Mus., vol. 11, p. 652, 1888.

Type.—In the United States National Museum.

This species, which is known only in the male, is very similar to *pyraustae*, differing, however, in having the metapleurum and propodeum even more completely and more strongly sculptured, in the roughened prepectus, in having the basal abdominal tergites yellow, in the broader face, and in the longer malar space, which is about as long as the clypeus.

Face nearly twice as broad as long to base of clypeus; eyes small; temples and cheeks somewhat rounded; antennae usually 38 to 42 segmented; scape, in the male, somewhat swollen; longest segment of maxillary palpus hardly as long as second segment of antennal flagellum; labial palpi much longer than face, the apical segment much lengthened; notauli foveolate; metapleura completely rugulose; propodeum coarsely reticulate; apical teeth of trochanters weak, indistinct; first discoidal cell very long; mediella about twice lower abscissa of basella; first abdominal tergite at least a third as long as the abdomen, longitudinally aciculate, the spiracles much farther from base than from each other; sculptured part of second tergite somewhat constricted at the middle; legs, as well as scape and pedicel, deep honey-yellow.

The above notes are based on the type, which is from Missouri; on five additional collected specimens in the national collection from Illinois, Minnesota, New York, Pennsylvania, and Massachusetts, respectively; and on three specimens, in the Philadelphia Academy of Natural Sciences, from New Jersey and Illinois. The specimen from New Jersey has the thorax almost entirely yellow.

6. **MACROCENTRUS LONGICORNIS** Provancher

Macrocentrus longicornis PROVANCHER, Nat. Can., vol. 12, p. 173, 1880.

Type.—In the Museum of Public Instruction, Quebec, Canada.

I have not seen the type of this species, but in the collection of the United States National Museum there are three specimens from Cleveland, Ohio, and one from Itasca State Park, Minn., which ap-

pear to agree so completely with the original description, and with notes made by S. A. Rohwer in 1915 on an examination of the type, as to leave little doubt that they are *longicornis*. The species, as represented by these specimens, is most similar to *pyraustae* and *harrisi*, but it can be readily separated by the characters mentioned in the key. The following additional notes are likewise based on the specimens in the National Museum: Malar space shorter than basal width of mandible; cheeks and temples rounded, full; antennae 37 to 44 segmented; ocell-ocular line twice the diameter of an ocellus; mandibles quite long, the apices crossing; face short and broad, nearly twice as broad as long; clypeus rather large, strongly convex; entire insect black except palpi, scape and pedicel of antennae, mandibles, legs, and the three basal sternites of the abdomen.

7. MACROCENTRUS PERONEAE, new species

Most similar to *harrisi*, but at once distinguished by its unusually short and relatively broad radial cell, the blackish abdominal sternites, the broader depressed lateral margins of second tergite, and by the lower abscissa of basella being scarcely longer than nervellus and scarcely half as long as mediella.

Female.—Length 4.5 mm. Head rather small, only very slightly wider than thorax; eyes broadly oval, not large; temples strongly receding; cheeks rounded; face broad, smooth, impressed medially above and with a short low ridgelike elevation just below this impression; clypeus small, convex, apically truncate; malar space fully as long as basal width of mandible; ocell-ocular line nearly twice diameter of an ocellus; maxillary palpi long, longest segment slightly longer than second flagellar segment; antennae longer than the body, 46-segmented.

Thorax with propodeum delicately rugulose; pleura smooth, except metapleura at apex; metapleural tooth not distinct; legs very slender; longer calcarium of posterior tibia hardly one-third the basitarsus; trochanters with the apical teeth minute, indistinct; stigma large, broad, emitting radius from very slightly beyond middle; radial cell unusually short, ending far before wing apex, measured on wing margin scarcely longer than stigma and not more than one and one-half times as long as broad; submedian cell closely hairy apically; nervulus postfurcal by less than half its length; radiellian cell long, not widening apically.

Abdomen longer than head and thorax combined; first tergite hardly twice as long as broad at apex, finely longitudinally aciculated; second slightly longer than broad at apex, also longitudinally aciculated, the depressed lateral margins broadest at base, the sculp-

tured part broadening gradually behind; third tergite aciculate on basal half; remainder of dorsum of abdomen smooth; ovipositor sheaths distinctly longer than the body, very slender.

Black; head black; clypeus brownish; palpi more or less dusky; antennae blackish, including scape and pedicel; thorax black with brownish tinge on sides of pronotum and on metapleura; wings hyaline; veins and stigma dark brown, the latter indistinctly paler at extreme base; legs brownish yellow; posterior femora at apex, posterior tibiae except at base, and all tarsi, blackish; abdomen black; second and third tergites with a faint brownish tinge; three basal sternites of abdomen piceous-black, the following black.

Type.—U.S.N.M. No. 43491.

Type locality.—Ottawa, Ontario, Canada.

Host.—*Peronea variana* Fernald.

Remarks.—Described from three female specimens reared by K. E. Schedl.

8. *MACROCENTRUS HARRISI* De Gant

Macrocentrus harrisi DE GANT, Proc. Ent. Soc. Washington, vol. 32, p. 164, 1930.

Type.—In the United States National Museum.

Exceedingly similar to *pyraustae*, but differing especially in the longer malar space, which is about as long as the clypeus, and in the darker abdomen, as noted in the key. Face broad, rather strongly transversely convex; eyes small; temples and cheeks rounded; ocelli very small, ocell-ocular line more than twice the diameter of an ocellus; antennae usually 42 to 48 segmented; notauli punctate; propodeum granularly rugulose; mesopleura mostly smooth, polished; metapleura rugulose on posterior half; apical teeth of trochanters minute, indistinct; nervulus slightly postfurcal; first discoidal cell very long; mediella less than twice as long as lower abscissa of basella, which is more than one and one-half times, sometimes nearly twice, as long as nervellus; three basal abdominal tergites closely longitudinally aciculate. Black; clypeus more or less reddish; scape and pedicel, palpi, base of mandibles, and the three basal sternites of abdomen, pale yellow; legs yellow, except the posterior tibiae outwardly and all the tarsi, which are more or less infuscated. Very rarely the thorax is pale beneath.

The material examined consists of the type and 10 additional specimens in the National Museum representing a range in distribution from the District of Columbia and New York to Colorado and northward to Alberta; two specimens in the collection of the Boston Society of Natural History from Mount Washington, N. H., and Mount Desert, Me., respectively; and 26 specimens from various New England localities at the gipsy moth laboratory, Melrose Highlands,

Mass. Three specimens in the national collection, from Washington, D. C., are recorded as having been reared from *Cacoecia parallela* Robinson, while among the material at the gipsy moth laboratory are 12 males reared from *Cacoecia purpurana* Clemens taken at Brewer, Me., and 4 males obtained from *Ewartema fasciatana* Clemens taken at Orrington, Me.

This species is evidently exceedingly similar to *nigridorsis* Viereck; in fact, I suspect that the two may be identical and that it may become necessary to suppress *harrisi* as a synonym, but since I have not seen the type or authentic material of *nigridorsis* I am for the present recognizing *harrisi* as valid.

9. *MACROCENTRUS PYRAUSTAE* Viereck

Macrocentrus pyraustae VIERECK, Connecticut Geol. and Nat. Hist. Surv. Bull. 22, p. 220, 1917 (1916).

Type.—In the Connecticut Agricultural Experiment Station at New Haven.

The characters that will distinguish *pyraustae* from *terminalis* and *harrisi*, both of which it closely resembles, have been mentioned in the discussion under those species or in the key. From *gifuensis*, which is also very similar, it differs principally in color as indicated in the table to species; but the mandibles, though short, are hardly as short as in *gifuensis*, distinctly crossing at the tips; the temples and cheeks are a little more strongly receding and the radial cell slightly shorter.

Antennae long, usually 43 to 46 segmented; maxillary palpi long, but the longest segment not distinctly so long as second segment of antennal flagellum; prepectal carina strong, complete; metapleura usually rugose on posterior half; propodeum mostly rugulose; apical teeth of trochanters minute, indistinct; radial cell ending considerably before apex of wing; first discoidal cell very long; abdomen very slender, the first tergite usually more than three times as long as wide at apex, and the second tergite in the female nearly twice as long as wide; ovipositor sheaths as long as the body. Head and thorax black or blackish; antennae blackish with scape and pedicel yellow; usually apex of scutellum and the surrounding parts brownish; abdomen black with third tergite bright testaceous, and often the second more or less pale; legs yellow, with posterior tibiae weakly infuscated.

The above discussion and descriptive notes are based on the type, two paratypes in the Philadelphia Academy of Natural Sciences, two paratypes, and two additional specimens reared from "a tortricid in turtle-head," at Ithaca, N. Y., in the national collection; and 31 specimens at the gipsy moth laboratory, which were reared from

Pyrausta pterextalis Lederer taken at Bedford and Hudson, Mass. The type series is recorded as apparently having been parasitic on *Pyrausta theseusalis* Walker.

10. *MACROCENTRUS GIFUENSIS* Ashmead

Macrocentrus gifuensis ASHMEAD, Proc. U. S. Nat. Mus., vol. 30, p. 191, 1906.

Type.—In the United States National Museum.

The following discussion and descriptive notes apply to the species that has been recently introduced into the United States from Europe and Japan as a parasite of the European corn borer (*Pyrausta nubilalis* Hübner), and has become established at several points in the area infested by that pest. I am not altogether satisfied that this parasite is identical with *gifuensis*, but owing to the variability within species of *Macrocentrus*, and to the fact that the two specimens comprising the type series of *gifuensis* appear to be somewhat abnormal, it seems advisable for the present to continue the use of this name for the parasite of the corn borer.

Very similar to *harrisi* and *pyraustae* but separable by the characters mentioned in the key and in the comments under those species. Face sparsely shallowly punctate; clypeus long, at least half as long as face; mandibles short, not, or scarcely, meeting at tips, the teeth very short; longest segment of maxillary palpus distinctly shorter than second segment of flagellum; malar space only about half as long as clypeus; ocell-ocular line more than twice diameter of an ocellus; antennae normally 40 to 44 segmented; notauli foveolate; propodeum finely rugulose, also metapleura posteriorly; apical teeth of trochanters minute, indistinct; radius arising from about middle of stigma; radial cell going nearly to wing apex; nervulus a little postfurcal; first discoidal cell very long; mediella hardly twice lower abscissa of basella, the latter usually about twice the nervellus; abdomen slender; first tergite in female about three times as long as broad at apex, relatively a little shorter in the male; first, second, and basal half of third, tergites longitudinally aciculate; ovipositor sheaths as long as the abdomen.

There is much variation in color: The head is always black, but the color of the thorax ranges from entirely testaceous to mostly black, with only the venter, the pleura below, and usually the pre-scutum, pale; usually at least the pronotum is blackish or somewhat infuscated; the abdomen is usually black or blackish with the third, or the second and third tergites mostly pale; sometimes the first tergite is also mostly yellowish; the legs are yellow; the wings hyaline.

Many specimens reared from *Pyrausta nubilalis* and received at the European Corn Borer Laboratory, Arlington, Mass., from Europe and Japan have been examined.

11. *MACROCENTRUS AMICROPLOIDES* Viereck

Macrocentrus amicroploides VIERECK, Proc. U. S. Nat. Mus., vol. 43, p. 579, 1912.

Type.—In the United States National Museum.

This species, which is a common gregarious parasite of various leaf-rollers, is relatively easily distinguished from all related forms by having the base and apex of stigma conspicuously pale, by the larger eyes and ocelli, by the narrower face, and by the color of the head and thorax. Eyes large; malar space usually less than basal width of mandible; face but very little or no broader than long; ocell-ocular line hardly one and one-half times as long as diameter of a lateral ocellus; longest segment of maxillary palpus a little longer than second segment of antennal flagellum; antennae normally 42 to 48 segmented; male scape somewhat swollen; propodeum finely rugulose; metapleura roughened posteriorly; apical teeth of trochanters minute, indistinct; radius arising from very slightly beyond middle of stigma; submedian cell closely hairy, not glabrous apically; mediella twice the lower abscissa of basella, the latter distinctly longer than nervellus; abdomen very slender, first, second, and usually most of third, tergites closely longitudinally striate; the first deeply excavated at base; second tergite much longer than broad, the lateral depressed margins very narrow; third tergite usually longer than broad, at least in the female; ovipositor sheaths slightly longer than the body.

In color the species is extremely variable. The color of the head ranges from entirely yellow to mostly black; nearly always at least occiput and vertex are blackish, the face more or less brownish and never entirely black; the thorax also varies from entirely testaceous to mostly black, but the sternum and lower part of pleura are virtually always pale, with the pronotum never blackish even in the darkest specimens; dorsum of abdomen most frequently black, although sometimes mostly yellowish; in the darkest specimens the sternites, too, are blackish; legs entirely yellow; wings hyaline, veins brownish, stigma brown, conspicuously pale at base and at apex and usually along anterior margin.

The national collection contains many specimens representing a range in distribution from Massachusetts to California; in addition to the type, two from Darby, Mont., are recorded as having been reared from *Cacoecia argyrospila* Walker, and two from St. Annes, Quebec, as having been obtained from *Tmetocera ocellana* Schiffermüller. Much additional material in the collection of the gipsy-moth laboratory has been examined. This includes series reared from *Cacoecia rosaceana* Harris, *C. rosana* Linnaeus, *Pyrausta per-textalis* Lederer, and *Harpipteryx frustrella* Walsingham, taken at various New England localities.

12. *MACROCENTRUS CROCIDOPHORAE*, new species

Closely resembles *amicroploides* but may be distinguished particularly by its unicolorous stigma, interstitial nervulus, and shorter mandibles. In the unusually short mandibles it resembles *gifuensis*, but differs from that species in having the head yellow and the nervulus interstitial.

Male.—Length 4 mm. Eyes large, prominent; face but little broader than long, smooth; temples not broad, receding; clypeus strongly convex; distance from clypeal foveae to eyes shorter than length of clypeus; ocell-ocular line less than twice the diameter of an ocellus; maxillary palpus long, the longest segment as long as the second flagellar segment; the two apical segments of labial palpus long; antennae very long and slender, 43-segmented; scape large, somewhat swollen.

Thorax slender, narrowing strongly anteriorly; prothorax narrow; middle lobe of mesoscutum prominent; notauli coarsely foveolate; scutellar furrow pitlike, considerably longer than half the scutellum; scutellum less than half as long as propodeum, which is rather long and narrow, transversely rugulose, the rugae prominent; metapleura rugose posteriorly; legs slender; longer calcarium of posterior tibia much less than half the basitarsus; basitarsus of anterior legs not more than half the tibia; radius arising from middle of stigma; radial cell going very nearly to apex of wing; first discoidal cell very long; submedian cell closely hairy; nervulus interstitial; mediella not distinctly twice as long as the lower abscissa of basella, the latter one and one-half times the nervellus, which is but very slightly longer than nervulus; radiella straight; radiellian cell a little the widest apically.

Abdomen very slender, longer than head and thorax; first tergite more than twice as long as wide, deeply impressed at base, irregularly longitudinally aciculated; spiracles of first tergite at end of basal fourth; second tergite longer than broad, parallel-sided, completely closely aciculate, the lateral depressed margins very narrow; third tergite also mostly aciculate; rest of dorsum of abdomen smooth.

Testaceous; vertex and occiput brownish; palpi pale; antennae brownish black, scape and pedicel yellow; fourth and following abdominal segments piceous; wings hyaline; stigma brown, without a pale spot at base; veins pale brown; legs entirely yellow.

Type.—U.S.N.M. No. 43492.

Type locality.—Baton Rouge, La.

Host.—*Crocidophora pustuliferalis* Lederer.

Remarks.—Described from three male specimens reared September 5, 1928, by H. Spencer.

13. MACROCENTRUS ATRATUS, new species

Agrees with *impressus* and differs from all other related species in having lower abscissa of basella longer than nervellus and about half as long as mediella. It is at once distinguished from *impressus*, however, by being mostly black.

Female.—Length 5.5 mm. Head a little wider than thorax; eyes very large; malar space much less than basal width of mandible; face strongly impressed medially above, mostly smooth except just above clypeus where it is closely finely punctate; clypeus strongly convex, truncate at apex; ocell-ocular line hardly one and one-half times the diameter of an ocellus; temples and cheeks very narrow, strongly receding; maxillary palpus long, the longest segment much longer than second segment of antennal flagellum and nearly as long as the first; apical segment of labial palpus much lengthened; antennae longer than the body, 49-segmented.

Thorax with prescutum prominently convex, descending abruptly in front; notauli foveolate only behind; propodeum finely sculptured except at base, more or less delicately obliquely aciculate; metapleural tooth prominent; mesopleura not impressed below, smooth, shining, with only scattered punctures; teeth outwardly at apex of trochanters conspicuous; stigma rather long, much more than twice as long as wide, emitting radius from much beyond middle; radial cell ending considerably before wing apex; first abscissa of cubitus straight, the second about half as long as recurrent; first discoidal cell very long, much longer than first cubital; nervulus postfurcal by scarcely half its length; submedian cell weakly hairy apically; lower abscissa of basella half as long as mediella and somewhat longer than nervellus; radiellian cell widening slightly apically.

Abdomen a little longer than head and thorax combined; first tergite twice as long as broad at apex, impressed at base, finely longitudinally aciculate, the spiracles beyond basal fourth; second tergite longer than broad, finely longitudinally aciculate, the smooth lateral depressed margins narrow at base, the sculptured part of the tergite as wide at base as at the middle; third tergite longitudinally aciculate on basal half; ovipositor sheaths a little longer than the body.

Head black; clypeus entirely ferruginous; palpi whitish; mandibles whitish at base; basal half of antenna, including scape and pedicel, brownish black, apical half paler; thorax blackish, with sternum and pleura mostly brownish yellow or ferruginous; legs yellow; wings hyaline; stigma and veins brown, the former not pale at base; abdomen black.

Type.—U.S.N.M. No. 43498.

Type locality.—Ithaca, N. Y.

Paratype locality.—Bar Harbor, Me.

Remarks.—Described from two female specimens, the type with only locality data, the paratype collected by C. W. Johnson on July 20, 1919. The latter specimen is in the collection of the Boston Society of Natural History. I have also seen a specimen of this species, from Pennsylvania, in the Philadelphia Academy of Natural Sciences.

14. *MACROCENTRUS IMPRESSUS*, new species

Superficially very similar to *delicatus*, but at once distinguished by the distinct impression at base of first tergite. Structurally most closely related to *atratus*, differing principally in its entirely yellow color.

Female.—Length 7.5 mm. Head a little broader than thorax; face medially impressed on upper half; lower part of face with scattered, very shallow punctures; clypeus convex, truncate at apex; malar space a little shorter than basal width of mandibles; eyes large, prominent; summit of vertex but little above level of upper eye margins; ocelli rather large; ocell-ocular line less than one and one-half times the diameter of ocellus; temples and cheeks very narrow; maxillary palpi long, the longest segment much longer than second segment of antennal flagellum and nearly as long as the first; antennae of type broken.

Thorax with prescutum strongly convex, prominent; notauli foveolate posteriorly; propodeum entirely finely reticulato-rugulose, most weakly sculptured at base; mesopleura with scattered well-separated punctures on lower half; metapleura smooth; calcaria of posterior tibiae thick; radius arising from much beyond middle of stigma; radial cell ending well before wing apex; metacarpus extending the length of second intercubitus beyond apex of radial cell; first discoidal cell very long; first abscissa of cubitus straight, the second nearly half as long as recurrent; nervulus postfurcal by about half its length; submedian cell with a hairless area apically; basal vein hardly curved; mediella less than twice as long as lower abscissa of basella, the latter much longer than nervellus; radiellian cell broadening slightly apically.

Abdomen slightly longer than head and thorax combined; basal impression of first tergite extending beyond line of spiracles; the spiracles about as far from base of tergite as from each other; first tergite finely longitudinally striate; second longer than broad, completely closely longitudinally aciculate except on the narrow lateral depressed margins, the sides of the raised sculptured part slightly emarginate at the middle; third tergite longer than broad, closely finely aciculate on basal two-thirds; ovipositor sheaths distinctly longer than the body.

Testaceous; head entirely yellow except the ocellar triangle which is black; antennae yellow; palpi very pale yellow; thorax and abdomen honey-yellow; legs bright honey-yellow; wings hyaline; veins brown; stigma entirely yellow.

Type.—U.S.N.M. No. 43499.

Type locality.—Pennsylvania.

Remarks.—Described from four female specimens, the type and two paratypes, labeled "Pa. 1573, C. F. Baker collection," which are in the National Museum, and one paratype in the collection of the Boston Society of Natural History, which was taken on the island of Marthas Vineyard, Mass., July 29, 1929, by F. M. Jones. This specimen has the antennae 55-segmented.

15. *MACROCENTRUS RETICULATUS*, new species

Distinguished from all related species by the unusually strongly rugoso-reticulate propodeum and the coarse sculpturing of the metapleura, combined with a long, closely ruguloso-aciculate first tergite with the spiracles near end of basal third.

Female.—Length 5.5 mm. Head but little wider than greatest width of thorax; face scarcely convex, smooth; eyes large, very prominent; malar space fully as long as basal width of mandible; clypeus strongly convex, not more than one and one-half times as broad as long, weakly broadly emarginate at apex; maxillary palpi long, the longest segment longer than second segment of antennal flagellum; antennae longer than the body, 46-segmented.

Thorax rather stout, broadest posteriorly; prescutum strongly convex, prominent; notauli foveolate posteriorly; propodeum unusually coarsely rugoso-reticulate, the sculpturing not transverse; impression on lateral face of pronotum unusually broad and deep anteriorly and coarsely foveate; lower part of mesopleura conspicuously depressed and strongly confluent punctate; prepectus completely margined and more or less rugulose; metapleura mostly ruguloso-punctate; legs very long and slender; apical teeth of trochanters rather weak; posterior femora longer than coxae and trochanters combined; posterior tibiae very long; radius arising from very slightly beyond middle of stigma; radial cell not quite attaining wing apex; first discoidal cell long; nervulus postfurcal by about half its length or slightly more; submedian cell with a hairless area apically; nervellus very slightly shorter than lower abscissa of basella, the latter a little less than half as long as mediella.

Abdomen slender, considerably longer than head and thorax combined; first tergite long and narrow, nearly three times as long as wide at apex, closely longitudinally ruguloso-striate, subopaque; second tergite much longer than wide, completely closely striate with

only very narrow lateral depressed margins; basal two-thirds of third tergite closely finely striate, subopaque; rest polished; ovipositor sheaths very slender, distinctly longer than the body.

Yellow-ferruginous; base of mandibles and the palpi yellowish white; vertex rather brownish; antennae brown, scape and pedicel testaceous; legs testaceous, with fore and middle coxae and trochanters paler; wings distinctly a little dusky; stigma brown with a pale spot at base; veins brown; apex of abdomen more or less infuscated.

Type.—U.S.N.M. No. 43500.

Type locality.—Coleta, Ala.

Remarks.—Described from four female specimens, collected by H. H. Smith at the type locality, and one additional female taken by R. A. Cushman at Difficult Run, Va., July 30, 1920. This last specimen is larger than the others, measuring 7.5 mm. in length, and is even a little more coarsely sculptured. One paratype has antennae 44-segmented; in the other paratypes they are broken.

16. *MACROCENTRUS CANARSIAE*, new species

Rather similar to *ancyliivorus*, but differing especially in the relatively longer and narrower, and completely striate, second abdominal tergite, in having lateral depressed margins of second tergite very narrow at base, in the third tergite being closely finely striate on basal half or more, and in the metacarpus extending well beyond apex of radial cell. From *insularis*, to which it is even more closely related, it differs as noted in the key.

Female.—Length 4.8 mm. Eyes large; temples and cheeks narrow, receding; malar space scarcely as long as basal width of mandible; face with only a few scattered weak punctures; vertex rising but very little above upper level of eyes; longest segment of maxillary palpus a little longer than second segment of flagellum and longer than scape and pedicel combined; antennae 49-segmented.

Thorax rather short; prescutum usually not especially prominent; notauli foveolate and not distinctly confluent posteriorly; propodeum reticulate posteriorly and weakly rugulose medially at base, smooth laterally on basal half; mesopleura and metapleura mostly smooth, with a few weak scattered punctures; longer calcarium of posterior tibia very nearly half as long as basitarsus; apical teeth of trochanters conspicuous; radius arising from very slightly beyond middle of stigma; radial cell ending well before extreme wing apex; metacarpus extending length of second intercubitus beyond apex of radial cell; first discoidal cell longer than first cubital; second abscissa of cubitus about half as long as recurrent; submedian cell weakly hairy at apex; nervulus postfurcal by barely

half its length; mediella much more than twice the length of lower abscissa of basella, the latter not distinctly as long as nervellus.

Abdomen longer than head and thorax combined, very slender, not half as wide as extreme width of thorax; first tergite more than twice as long as broad at apex, longitudinally striate, its spiracles before end of basal fourth; second tergite longer than broad, completely aciculate, the lateral depressed margins very narrow, not wider at base than at middle of tergite; third tergite about as long as broad, aciculate on basal two-thirds; ovipositor sheaths very slightly longer than the body.

Entirely testaceous except for a weak suggestion of infuscation at apex of propodeum, at base of first tergite, and on apical abdominal tergites; antennal flagellum usually fuscous, the scape and pedicel pale yellow; legs mostly testaceous, posterior coxae infuscated apically above; wings hyaline, veins and stigma brownish, the latter with a pale spot at base.

Type.—U.S.N.M. No. 43502.

Type locality.—Bentonville, Ark.

Host.—*Canarsia* sp.

Remarks.—Described from three female specimens reared in the Bureau of Entomology by D. Isely, July 20, 1918 (type), July 21, 1918, and June 18, 1919 (paratypes), the type and first paratype under Quaintance No. 16392, the second paratype under Quaintance No. 16472.

17. *MACROCENTRUS INSULARIS*, new species

Most closely related to *canarsiae*, but distinguished by the characters given in the key.

Female.—Length about 7 mm. Face broad, sparsely punctate; eyes large, prominent; malar space hardly as long as basal width of mandible; clypeus about as broad as half the width of face; mandibles stout; ocell-ocular line about one and one-half times as long as diameter of an ocellus; maxillary palpi long, the longest segment distinctly longer than second segment of antennal flagellum; apical segment of labial palpus nearly as long as the two preceding segments combined; antennae 54-segmented.

Thorax rather stout; notauli foveolate behind, propodeum finely rugulose; mesopleura and metapleura mostly smooth, with some scattered shallow punctures; apical teeth of all trochanters well developed; radius arising from distinctly beyond middle of stigma; radial cell rather short, the metacarpus extending the length of second intercubitus beyond apex of radial cell; nervulus postfurcal by about half its length; submedian cell sparsely hairy apically; mediella much more than twice the lower abscissa of basella, the latter hardly as long as nervellus.

Abdomen with first tergite much more than twice as long as broad at apex, closely longitudinally aciculate, the spiracles slightly beyond basal fourth and about as far from base of tergite as from each other; second tergite longer than broad, entirely finely aciculate, the lateral depressed margins very narrow; third tergite about as long as broad, aciculate on basal half; following tergites smooth; ovipositor sheaths as long as the body.

Yellow-ferruginous; palpi pale yellow; antennal flagellum fuscous or blackish; mesonotal lobes and metanotum more or less fuscous or blackish; posterior coxae a little dusky at apex above; wings hyaline, stigma brown, conspicuously paler at base.

Type.—In the collection of the Boston Society of Natural History.

Type locality.—The island of Marthas Vineyard, Mass.

Remarks.—Described from six female specimens taken by F. M. Jones in July and August, 1930. The two paratypes with complete antennae have them 53-segmented. There is more or less variation in the extent of the fuscous or blackish markings of thorax; the posterior coxae are sometimes entirely pale, and occasionally the apex of the abdomen is blackish. Two of the paratypes are deposited in the United States National Museum.

18. *MACROCENTRUS CLYPEATUS*, new species

Most similar to *robustus* but at once separated by the unusually broad clypeus, the much smaller, nonprominent eyes, and the broader face.

Female.—Length 5.5 mm. Head much wider than thorax, rather lenticular as seen in profile; face broad, nearly or quite twice as broad as long, polished; eyes not large, not prominent, extending but little beyond outer margin of temples; temples and cheeks somewhat rounded; clypeus broader than length of second segment of antennal flagellum; mandibles large, stout, the outer tooth very strongly developed; vertex scarcely convex; ocell-ocular line very nearly twice the diameter of a lateral ocellus; maxillary palpi scarcely longer than width of head, the longest segment not distinctly as long as second segment of antennal flagellum; labial palpi short, about as long as face; antennae 49-segmented.

Thorax rather stout; notauli finely foveolate; propodeum transversely aciculate, smooth at base; mesopleura a little impressed below, smooth, shining, with only a few setigerous punctures; metapleura smooth; prepectus defined only laterally; apical teeth of all trochanters well developed, conspicuous; radius arising from slightly beyond middle of stigma; metacarpus extending hardly beyond apex of radial cell; first discoidal cell considerably longer than first cubital; second abscissa of cubitus nearly half as long as recurrent;

nervulus postfurcal by about half its length; submedian cell with a hairless area apically; mediella nearly three times as long as lower abscissa of basella, the latter a little shorter than nervellus.

Abdomen not, or only indistinctly, longer than head and thorax combined, a little narrower than thorax; first tergite not twice as long as broad at apex, only weakly impressed at extreme base, delicately longitudinally aciculate, the spiracles before end of basal fourth, the distance between them much greater than the distance from spiracles to base of tergite; second tergite hardly as long as broad at apex, delicately aciculate on basal two-thirds, the smooth depressed lateral margins broad at base, the sculptured part of tergite distinctly narrower at the base than at the middle; following tergites smooth; ovipositor sheaths not distinctly longer than the body.

Yellow-ferruginous; head testaceous; palpi yellow; antennae fuscous, scape and pedicel testaceous; thorax yellow-ferruginous; legs yellowish, also the abdomen entirely; wings faintly dusky, veins and stigma brown, the latter broadly yellow at base.

Male.—Agrees with the female in essential respects; the antennae are 48-segmented and the eyes a little smaller.

Type.—U. S. N. M. No. 43505.

Type locality.—Germantown, Pa.

Allotype locality.—Glen Echo, Md.

Paratype localities.—Falls Church, Va.; Avon, N. J.

Remarks.—Described from three females and one male. The type was collected September 25, the allotype, September 19, 1920, by J. C. Bridwell; the paratype from Falls Church, Va., was taken by R. A. Cushman September 24, 1918, while the other paratype was collected on September 27, 1908. This last-mentioned specimen has the antennae 45-segmented and the stigma mostly yellow.

19. MACROCENTRUS ROBUSTUS, new species

Closely related to *ancyliivorus*, but distinguished especially by its more robust form, the unusually broad first abdominal tergite, the longer antennae, which are usually 50 to 54 segmented, and the somewhat broader face and clypeus.

Female.—Length 7 mm. Head very strongly transverse, short antero-posteriorly; eyes prominent; malar space a little longer than basal width of mandible; face smooth, with only minute scattered punctures; clypeus large, broad, more than twice as broad as long and fully as broad as length of scape, rather strongly broadly emarginate at apex; mandibles stout; longest segment of maxillary palpus about as long as second segment of antennal flagellum;

apical segment of labial palpus very little longer than the preceding segment; antennae of type broken.

Thorax stout; scutellum large, more than half as long as propodeum; propodeum finely, more or less transversely, sculptured; pronotum laterally polished, without foveae in the depression; mesopleura smooth; metapleura a little roughened on apical half; apical teeth of trochanters well developed, conspicuous; radius arising from a little beyond middle of stigma; nervulus postfurcal by about half its length; submedian cell sparsely hairy apically; nervellus usually a little longer than lower abscissa of basella.

Abdomen stout; first tergite unusually broad, usually not distinctly one and one-half times as long as broad at apex, delicately, irregularly, longitudinally aciculate; distance between spiracles of first tergite usually greater than half the basal width of propodeum; second tergite not quite as long as broad, faintly longitudinally aciculate on basal two-thirds, the depressed lateral margins unusually broad at the base; third tergite much broader than long; third and following polished; ovipositor sheaths about as long as the body.

Yellow-ferruginous; palpi paler; base of mandibles concolorous with face; antennae brown, scape and pedicel paler; propodeum more or less infuscated except anteriorly; first tergite also in part more or less dusky; legs deep testaceous; wings hyaline; stigma brown, conspicuously pale at base, or yellow with a brownish cloud in apical half.

Male.—In the allotype the propodeum is darker than in the type; also the first tergite, except at apex, and the fourth and following tergites are blackish.

Type.—U.S.N.M. No. 43507.

Type locality.—Chatham, Mass.

Host.—*Pyrausta nubilalis* Hübner.

Remarks.—Described from eight females and six males: The type, allotype, and eight paratypes reared in the Bureau of Entomology by R. A. Biron from *P. nubilalis* taken at the type locality; three paratypes reared by D. W. Jones from the same host, taken at Salem, Mass., under Webster No. 16490; and one paratype taken at Glassboro, N. J. I have seen 27 additional specimens, all reared from *P. nubilalis* taken in eastern Massachusetts, in the collection of the corn borer laboratory at Arlington, Mass. In this material the number of segments in the antennae ranges from 50 to 54. There is a little variation in color of thorax and abdomen, but the mesoscutum and the second and third abdominal tergites are always entirely testaceous. In length these specimens range from 5.5 to 7 mm.

20. *MACROCENTRUS NIGRIPECTUS*, new species

Most similar to *ancylivorus*, but distinguishable by the black markings on mesonotal lobes and mesosternum, by the second tergite being completely aciculate, by the lower part of mesopleura being closely punctate and subopaque, and by the more distinctly foveolate notauli.

Female.—Length 4.2 mm. Face at least one and one-half times as wide as long, convex, smooth, with only a few fine scattered punctures, and with a finely impressed median line above; clypeus strongly convex, not twice as wide as long, subtruncate at apex; eyes prominent, but not large; malar space longer than basal width of mandible; maxillary palpi a little longer than width of head, longest segment hardly as long as second segment of antennal flagellum; labial palpi short, apical segment but little longer than the preceding segment; vertex a little convex; ocell-ocular line twice the diameter of a lateral ocellus; antennae 45-segmented.

Thorax with notauli very finely foveolate; prescutum prominent, descending abruptly in front; scutellum small, hardly half as long as propodeum; propodeum completely finely rugulose, transversely so behind; impression on lateral face of pronotum more or less foveolate; mesopleura impressed and closely punctate on lower half; metapleura finely granularly roughened and subopaque posteriorly; anterior trochanters not longer than their coxae, apical teeth of all trochanters well developed; posterior coxae faintly transversely lineolated; radius arising from barely beyond middle of stigma; first discoidal cell much longer than first cubital; nervulus postfurcal by about half its length; submedian cell closely hairy, without a hairless area apically; mediella much more than twice as long as lower abscissa of basella, the latter about as long as nervellus; upper abscissa of basella but little more than half the lower.

Abdomen only faintly longer than head and thorax combined; first tergite twice as long as broad at apex, a little impressed at extreme base, entirely closely finely longitudinally aciculate, the spiracles much farther from each other than from base of tergite; second tergite also completely aciculate, except on the depressed lateral margins which are broad toward base; third tergite very delicately aciculate, at least medially on basal half; ovipositor sheaths distinctly longer than the body.

Yellow-ferruginous; vertex rather brownish; antennae brownish, blackish toward apex, scape yellowish brown; palpi brown or piceous; mesonotal lobes mostly black; mesosternum blackish posteriorly; legs testaceous; wings subhyaline; stigma yellowish, weakly clouded apically; veins brownish; first abdominal tergite somewhat brownish; apical tergites blackish.

Male.—Similar to the female; antennae of allotype 44-segmented.

Type.—U.S.N.M. No. 43501.

Type locality.—Whitesbog, N. J.

Host.—*Ancylis*, species near *comptana* Frölich.

Remarks.—Described from nine female and six male specimens reared by H. B. Scammell July 30 to August 8, 1916, in the Bureau of Entomology under Quaintance No. 12782. I have seen one other specimen, not part of the type series, which is in the collection of the gipsy moth laboratory and which was taken at North Saugus, Mass., June 14, 1906, by E. A. Back.

21. *MACROCENTRUS ANCYLIVORUS* Rohwer

Macrocentrus ancylivora ROHWER, Proc. Ent. Soc. Washington, vol. 25, p. 168., 1923.

Type.—In the United States National Museum.

This species is of particular interest to economic entomologists at the present time owing to the apparent importance it has assumed as a parasite of the introduced oriental fruit moth (*Laspeyresia molesta* Busck). It is, however, only one of several species of *Macrocentrus* that are being obtained from the larvae of that pest in the eastern part of the United States, and because of the variation occurring within species and the little attention that has been given to the classification of the species of *Macrocentrus*, some uncertainty has existed regarding the identity of specimens reared from *L. molesta*.

From *delicatus*, which in some areas appears to be at least as important a parasite of the fruit moth as *ancylivorus*, the latter is easily distinguished by having the first tergite more or less impressed at base, with the spiracles not beyond the basal fourth, while in *delicatus* there is not even a suggestion of an impression at base of first tergite and the spiracles are much beyond the basal fourth; in addition, the stigma of *delicatus* is always pale yellow, the radius arises from much beyond the middle of stigma, the nervulus is usually postfurcal by as much as its own length, and the antennae are usually 48 to 55 segmented; *ancylivorus* has the stigma usually brown, with a large pale spot at base, the radius arising from only slightly beyond middle of stigma, the nervulus never postfurcal by as much as its own length, and the antennae usually 42 to 48 segmented.

From *instabilis* and *laspeyresiae*, which are rather less commonly reared from *L. molesta*, *ancylivorus* is sometimes less easily distinguished. It differs from both species, however, in the shorter palpi, the longest segment of maxillary palpus being no longer, usually shorter, than the second segment of the antennal flagellum,

and the apical segment of the labial palpus being but little longer than the preceding segment. In having the nervulus postfurcal by distinctly less than its length, the mesonotum completely testaceous without blackish markings on the lobes, the second and third tergites always entirely testaceous, the base of mandibles testaceous rather than yellowish white, and the male scape not strongly enlarged, *ancylivorus* differs further from most specimens of those two species. Moreover, the second and third abdominal tergites are smoother than is usually true in *instabilis*, while the cheeks are narrower and the antennae usually with fewer segments than in *laspeyresiae*.

The face is usually considerably broader than long, although not so distinctly so in some specimens from the Southern States, in these cases an increase in the size of the eyes being accompanied by a correspondingly narrower face and shorter malar space; antennae usually 42 to 48 segmented, the scape of the male not much thickened; thorax with pleura mostly smooth; first discoidal cell much longer than first cubital; submedian cell usually only weakly hairy apically; mediella nearly three times as long as lower abscissa of basella; second abdominal tergite usually smooth posteriorly, and with the depressed lateral margins broad at base; the third tergite usually smooth or with only faint suggestion of lineolation; ovipositor sheaths as long as the body. Testaceous or testaceo-ferruginous, with more or less of metanotum, propodeum, first tergite, and the fourth and following tergites often more or less blackish or infuscated.

The foregoing discussion and descriptive notes are based very largely on the type series and many other specimens in the national collection representing a range in distribution from New Jersey to Texas and New Mexico. The principal host appears to be *Laspeyresia molesta* Busck; but the type series and some additional specimens were reared from the strawberry leaf-roller (*Ancylis comptana* Frölich), while others are recorded from the larvae of *Epiblema strenuana* Walker (Moorestown, N. J., 1929), *Canarsia* sp. (Bentonville, Ark., 1919), *Epagoge* sp. (Virginia, 1910), *Homeosoma electellum* Hulst, *Anacampsis* sp. (Texas), and *Carpocapsa pomonella* Linnaeus (New Mexico, 1912); I have also seen considerable additional material, all from *L. molesta*, sent me by H. W. Allen, in charge of the oriental fruit moth investigations of the Bureau of Entomology, at Moorestown, N. J., and by W. E. Britton, of the Connecticut Agricultural Experiment Station. Still other material studied includes collected specimens in the collection of the Boston Society of Natural History, taken on the islands of Nantucket and Marthas Vineyard, Mass., and at Fall River, Mass. (1913); and a

series at the gipsy moth laboratory, reared July, 1917, from *Ecartema sericorana* Walsingham, taken at Westerly, R. I.

22. *MACROCENTRUS INSTABILIS*, new species

Most similar to *laspeyresiae*, but differing in the usually narrower and smoother face, the shorter malar space, the usually entirely brown stigma, in the mesoscutum posteriorly being usually more sharply emarginate, with the scutellar furrow not strongly transverse, in the relatively longer and narrower second abdominal tergite, the usually stronger sculpturing of second and third tergites, and the somewhat smaller size.

Female.—Length 5 mm. Head strongly transverse, much wider than thorax, eyes large, prominent; malar space shorter than basal width of mandible; face, viewed from in front, not or but little broader than long, entirely smooth and shining; clypeus strongly convex, rather long, broadly very weakly emarginate at apex, smooth; distance from clypeal foveae to eyes less than length of clypeus; palpi slender, longest segment of maxillary palpus distinctly longer than second segment of antennal flagellum, apical segment of labial palpus lengthened; antennae longer than the body, 49-segmented in type.

Thorax slender; prescutum prominent; notauli minutely indistinctly foveolate; propodeum very finely transversely rugulose, smooth at base laterally; sides of pronotum, mesopleura and metapleura polished; coxae polished; apical teeth of trochanters distinct but usually not more than three or four on each trochanter; radius arising from middle of stigma; radial cell extending very nearly to extreme apex of wing; first discoidal cell much longer than the first cubital; nervulus usually postfurcal by as much as its own length; submedian cell with a hairless area apically; mediella nearly three times as long as lower abscissa of basella, the latter just about as long as nervellus and but little longer than upper abscissa of basella.

Abdomen but very little longer than head and thorax combined; first tergite twice as long as broad at apex, closely finely longitudinally aciculate, impressed at base, spiracles a little farther from each other than from base of tergite; second tergite slightly longer than broad, closely finely completely aciculate, the lateral depressions usually narrow at base; third tergite mostly finely aciculate on basal half; rest smooth; ovipositor sheaths a little longer than the body.

Head testaceous; palpi and base of mandibles very pale yellow; antennae mostly yellowish, the basal flagellar segments darker; dorsum of thorax mostly piceous in type; propodeum blackish; pleura

testaceous; mesosternum tinged with brown; legs yellow, usually very pale at base; wings entirely clear hyaline; stigma uniformly brown, only very indistinctly paler at base; dorsum of abdomen mostly black, the apical segments a little paler.

Male.—Not differing in any important respect from the female. The antennae of allotype are 47-segmented; the scape is somewhat swollen, distinctly larger than in the female.

Type.—U.S.N.M. No. 43503.

Type locality.—Harriman, Tenn.

Host.—*Laspeyresia molesta* Busck.

Remarks.—Described from 12 females and 14 males reared by H. G. Butler, September, 1930. The national collection contains, in addition to the type series, one specimen from *L. molesta*, taken at South River, N. J.; three reared from *Laspeyresia funebrana* Treitschke at Washington, D. C. (W. B. Wood); also one reared from *Coloeophora malivorella* Riley at the same locality; several from the last-mentioned host taken at Morgantown, W. Va. (E. Gould); a series from *L. molesta* collected at several different points in Ohio; several specimens reared from *Acrobasis caryivorella* Ragonot at College Station, Tex. (S. W. Bilsing); and one from *Acrobasis hebescella* Hulst at Victoria, Tex. I have also seen two specimens reared from *L. molesta*, at Chambersburg, Pa., by J. O. Pepper and J. R. Stear, respectively.

There is much variation in color, the thorax and abdomen ranging from entirely blackish dorsally to completely yellow, and in the palest specimens the stigma is usually yellow rather than brown. In the specimens from Texas, which are the palest, the eyes and ocelli are a little larger than in more northern material.

23. MACROCENTRUS UTILIS, new species

Most closely resembling *laspeyresiae*, but differing especially in having the second tergite completely, and the basal half of the third, closely aciculate, in the more strongly elevated prescutum, in the more strongly transverse head, and in the more uniform yellowish-ferruginous color.

Female.—Length 7.5 mm. Head strongly transverse, temples and cheeks narrow, the cheeks, viewed from the side, not wider than the temples; face rather large, much broader than long, very shallowly sparsely punctate; eyes large, prominent; malar space about as long as basal width of mandible; clypeus quite strongly convex, anterior margin truncate; distance from clypeal foveae to eyes about equal to length of clypeus; lateral ocelli usually not distinctly larger than median ocellus; longest segment of maxillary palpus a little longer than second segment of antennal flagellum; apical segment of labial

palpus much longer than preceding segment; antennae much longer than the body, 54-segmented in type; first flagellar segment very long, a little longer than the eyes.

Thorax rather stout, deep; prescutum very prominent; notauli foveolate posteriorly; scutellum elongate, more than half as long as propodeum; propodeum ruguloso-reticulate; sides of pronotum mostly smooth, the impression straight, weakly foveate; mesopleura smooth above, confluent punctate below; metapleura faintly shagreened, subopaque; posterior coxae delicately transversely lineolated posteriorly; apical teeth of trochanters well developed, conspicuous; radius arising from scarcely beyond middle of stigma; radial cell extending very nearly to extreme apex of wing; submedian cell weakly hairy, with a completely hairless area apically; nervulus post-furcal by nearly its own length; mediella nearly three times as long as lower abscissa of basella, the latter but little longer than the upper abscissa and not distinctly as long as nervellus.

Abdomen distinctly longer than head and thorax combined; first tergite fully twice as long as broad at apex, closely finely aciculate, the spiracles about as far from each other as from base of tergite; second tergite slightly longer than broad, completely closely finely aciculate, the lateral depressed margins narrow, the sculptured part of the tergite not, or scarcely, widening from base to middle; third tergite very nearly as long as broad at apex, delicately aciculate on basal two-thirds; remainder of dorsum of abdomen smooth; ovipositor sheaths a little longer than the body.

Yellow-ferruginous; antennae testaceous, blackish apically, the two or three basal flagellar segments not darker than the following; palpi pale yellow; legs concolorous with body; wings hyaline or subhyaline, stigma brownish yellow, indistinctly paler at base; veins dark brown; propodeum and first abdominal tergite weakly tinged with reddish brown.

Male.—Essentially similar to the female; antennae of allotype 52-segmented, the scape somewhat swollen; flagellum brownish.

Type.—U.S.N.M. No. 43504.

Type locality.—Carlisle, Iowa.

Host.—*Pyrausta ainsliei* Heinrich.

Remarks.—Described from seven female and six male specimens reared by G. C. Decker at the Iowa Agricultural Experiment Station, June, 1926. The national collection contains, in addition to the type series, 14 specimens reared from the same host at Manhattan, Kans., by R. Schopp; and one specimen collected by H. H. Smith at Coleta, Ala. I have also seen four specimens in the collection of the European Corn Borer Laboratory at Monroe, Mich., from Carroll County, Ind., and likewise reared from *P. ainsliei*.

There is very little variation in color in this material, the entire insect being rather uniformly yellow-ferruginous with only the propodeum and first tergite sometimes weakly infuscated. The number of segments in the antennae ranges from 50 to 56.

24. *MACROCENTRUS LASPEYRESIAE*, new species

Very similar to *instabilis*, *utilis*, and *ancylivorus*. The more important differences are discussed under those species.

Female.—Length 6 mm. Head rather large, much broader than thorax; as seen from the side the head appears fully as thick antero-posteriorly at the level of the lower eye margins as at the insertion of antennae, the cheeks being broader than temples; clypeus not especially strongly convex, more than twice as broad as long; distance from clypeal foveae to eyes less than length of clypeus; face usually nearly one and one-half times as broad as long, with well separated punctures; longest segment of maxillary palpus longer than second segment of antennal flagellum; apical segment of labial palpus long; antennae much longer than the body, 53-segmented in the type.

Thorax elongate; prescutum not especially prominent, rather less strongly elevated and descending less abruptly anteriorly than in related species; notauli not distinctly foveolate; scutellum more than half as long as propodeum; propodeum narrowing quite strongly behind, finely granularly rugulose on basal half, except laterally at base where it is mostly smooth, more or less transversely striate apically; sides of pronotum and the pleura smooth, with only scattered punctures; coxae smooth; apical teeth of trochanters strong, conspicuous; trochanters of middle legs usually with six or eight teeth; radius arising from very slightly beyond middle of stigma; radial cell long but not quite attaining extreme apex of wing; metacarpus hardly extending beyond apex of radial cell; submedian cell only very sparsely hairy; nervulus postfurcal by nearly its own length; mediella much more than twice as long as lower abscissa of basella, the latter not distinctly as long as nervellus.

Abdomen a little longer than head and thorax combined; first tergite more than twice as long as broad, with a distinct impression at base, and entirely closely longitudinally aciculate, the spiracles not distinctly beyond basal fourth and farther from each other than from base of tergite; second tergite not distinctly longer than broad at apex, mostly finely aciculate, smooth apically, the depressed lateral margins broad at base, the raised sculptured part of the tergite broadening gradually behind; third tergite smooth, with only faint longitudinal lineolation medially; remaining tergites smooth; ovipositor sheaths as long as the body.

Head yellow; vertex and occiput brownish; antennae brown or brownish yellow, the basal flagellar segments usually more or less blackish; thorax yellow, the mesonotal lobes more or less fuscous or blackish; metanotum and propodeum blackish; legs entirely yellow; wings hyaline; stigma yellow with a large brownish cloud, or brown, broadly pale at base; abdomen yellow, with first tergite black, the second blackish on basal half, the third more or less infuscated medially, the following mostly yellowish.

Male.—Similar to the female, except that the scape is rather conspicuously thickened; antennae of allotype 49-segmented; abdomen more completely blackish above than in the type, and antennae darker.

Type.—U.S.N.M. No. 43506.

Type locality.—Kanawha Station, W. Va.

Host.—*Laspeyresia caryana* Fitch.

Remarks.—Described from six female and five male specimens reared September 7, 1906, by Dr. A. D. Hopkins, at the type locality, and one female and three males reared at Richmond, Ohio, by A. A. Girault.

In addition to the type series, the national collection contains specimens reared from *Laspeyresia molesta* Busck at Moorestown, N. J.; from *Carpocapsa pomonella* Linnaeus in Virginia, Ohio, and Arkansas; from *Acrobasis* species in Texas; from *Rhyacionia rigidana* Fernald at Valparaiso, Fla.; and from *Laspeyresia caryana* at A. and M. College, Miss. There is considerable variation in color, both in the type series and in the additional specimens just mentioned, but nearly always the mesonotal lobes, the metanotum, the propodeum, and the three basal abdominal tergites are at least somewhat infuscated; the stigma rarely is entirely yellowish without a distinct cloud.

25. MACROCENTRUS MELLIPES Provancher

Macrocentrus mellipes PROVANCHER, Nat. Can., vol. 12, p. 172, fig. 19, 1880.

Type.—In the Museum of Public Instruction, Quebec, Canada.

This species, the type of which I have not seen, has been placed in the key on the basis of the original description and supplemental notes made by S. A. Rohwer on an examination of the type in 1915. The United States National Museum contains a single female specimen from Montana, which appears to agree with *mellipes* in structure, sculpture, and color, and although it is somewhat smaller than the type I believe it to be that species. Evidently *mellipes* is very similar to *aegeriae* but can be separated by the characters given in the key.

26. *MACROCENTRUS AEGERIAE* Rohwer

Macrocentrus aegeriae ROHWER, Proc. Ent. Soc. Washington, vol. 17, p. 56, 1915.

Type.—In the United States National Museum.

Rather easily distinguished from other Nearctic species by the characters ascribed to it in the key. Apparently it is most similar to *mellipes* but differs especially in the black posterior tibiae. It is exceedingly close to the European *marginator* (Nees), and may, in fact, be identical with that species, which is also a parasite of Aegeriidae, but I should like to see additional material of *marginator* before synonymizing *aegeriae* with it.

In length *aegeriae* ranges from 6 mm. to nearly 10 mm. The head is only very little wider than thorax; face broad, punctate; clypeus large; eyes not large; malar space usually longer than basal width of mandible; antennae 41 to 49 segmented; longest segment of maxillary palpus slightly longer than second segment of antennal flagellum; mesopleura closely punctate below; metapleura punctate; apical teeth of middle and posterior trochanters well developed; first cubital cell very large, at least as long as first discoidal; second abscissa of cubitus much more than half as long as recurrent vein; radius arising from far beyond middle of stigma; submedian cell sparsely hairy; nervulus usually postfurcal by less than half its length; mediella usually a little more than twice as long as the lower abscissa of basella, the latter about as long as nervellus; abdomen with first two tergites, and usually more or less of third, aciculate; first tergite strongly impressed at base; ovipositor sheaths fully as long as the body. Black; antennae black; lower part of mesopleura and the mesosternum often ferruginous; legs testaceous, the posterior femora at apex, posterior tibiae except at base, and the posterior tarsi, black; wings subhyaline; stigma entirely brown; veins brown.

The material examined consists of the type and about 30 additional specimens in the national collection from localities in New York, Pennsylvania, Connecticut, Virginia, West Virginia, Michigan, North Carolina, Mississippi, Louisiana, Kansas, Idaho, California, and Washington; and two specimens in the collection of the Boston Society of Natural History, from New Hampshire and Maine, respectively. Hosts recorded in the case of the material in the National Museum include *Synanthedon castaneae* Busck, *S. exitiosa* Say, *S. pictipes* Grote and Robinson, *S. tipuliformis* Linnaeus, *S. americana* Beutenmüller, *Proteopteryx bolliana* Slingerland (?), *Laspeyresia cupressana* Kearfott, an undetermined aegeriid larva in flowering dogwood, and an undetermined larva in rhododendron.

27. *MACROCENTRUS PULCHRIPENNIS*, new species

Most closely related to *seminiger*, from which it differs especially in the smaller, nonprominent eyes, the broader face, the broad, very weakly convex clypeus, the shorter palpi, the impunctate pleura, and the paler basal abdominal tergites.

Female.—Length 4.5 mm. Head rather small, in profile lenticular; face very broad, twice as broad as long, temples and cheeks convex; eyes not large, long oval, about one and one-half times as long as wide, not prominent, not distinctly extending beyond outer margins of temples; clypeus short and broad, nearly flat, subtruncate at apex; distance from clypeal foveae to eyes longer than length of clypeus; mandibles long; ocell-ocular line nearly twice diameter of an ocellus; maxillary palpi scarcely longer than height of head, the longest segment shorter than second flagellar segment; labial palpi very short, distinctly shorter than face from antennal foramina to clypeus; antennae unusually slender, only slightly longer than body, 42-segmented.

Propodeum more or less transversely ruguloso-striate, nearly smooth at base; sides of pronotum and the mesopleura and metapleura completely smooth and shining, impunctate; metapleural tooth not distinct; mesosternal suture deeply impressed posteriorly; legs very slender; apical teeth of posterior trochanters very weak, those of anterior and middle trochanters well developed; radius arising from considerably beyond middle of stigma; radial cell rather short, ending much before apex of wing; second abscissa of radius in type shorter than the first, also much shorter than first intercubitus, first cubital cell very long, not distinctly shorter than first discoidal; second abscissa of cubitus fully half as long as recurrent vein; nervulus postfurcal by less than half its length; submedian cell very weakly hairy; the setae of basal half of wing very short and indistinct; mediella more than twice as long as lower abscissa of basella, the latter shorter than nervellus; radiella not sinuate near middle, radiellian cell not widening at apex; upper abscissa of basella interstitial with transverse abscissa of subcostella; fringe of hairs on posterior margin of hind wing unusually short.

Abdomen a little longer than head and thorax combined; first tergite flattened, weakly impressed at base, polished basally, very weakly aciculate on apical half; spiracles not beyond basal fourth, and farther from each other than from base of tergite; rest of abdomen polished, with only very faint suggestion of aciculation basally on second tergite; second and third tergites fused, the second suture altogether wanting; ovipositor sheaths a little longer than the body. Head ferruginous; palpi and antennae blackish, scape and pedicel ferruginous; thorax ferruginous, with propodeum

blackish; legs yellowish brown; wings unusually clear hyaline, iridescent; stigma dark brown with a small pale spot in the membrane at base; abdomen brownish ferruginous, more or less infuscated, the fourth and following tergites black.

Type.—U.S.N.M. No. 43494.

Type locality.—Richfield, Utah.

Remarks.—Described from one female taken at a light trap, June 15, 1929.

28. *MACROCENTRUS SEMINIGER*, new species

Closely allied to *pulchripennis* but differing as noted in the key and in the discussion under that species. Also very similar to *affinis*, from which it may be distinguished by the entirely black abdomen and black posterior tibiae.

Female.—Length 6.5 mm. Face smooth, with some weak punctures above clypeus, also just below antennae; eyes large, extending prominently beyond outer margins of temples; clypeus strongly convex; distance from clypeal foveae to eyes shorter than length of clypeus; maxillary palpi about as long as width of head; two apical segments of labial palpus subequal; antennae as long as the body or very slightly longer, 39-segmented, tapering to apex. Thorax rather stout, deep; prescutum prominently elevated; notauli distinctly foveolate; propodeum rather broad, strongly convex, irregularly transversely striate, more or less smooth basally; prosternum, sides of pronotum, mesopleura, and metapleura uniformly punctate, shining; coxae polished; calcaria of posterior tibia slender, the longer calcarium nearly half as long as basitarsus; radius arising from beyond middle of stigma; apex of radial cell considerably before wing apex; metacarpus extending about length of second intercubitus beyond apex of radial cell; first discoidal cell slightly longer than first cubital; second abscissa of cubitus half as long as recurrent; nervulus only slightly postfurcal; submedian cell nearly glabrous, with only scattered rather indistinct hairs; mediella more than twice lower abscissa of basella, the latter about equal to nervellus; upper abscissa of basella interstitial with transverse abscissa of subcostella; radiellian cell not broadening at all at apex. Abdomen not distinctly longer than head and thorax combined; first tergite rather stout, hardly twice as long as broad, broadly impressed at base, finely longitudinally aciculate; second tergite only very faintly aciculate at base, not separated from third, the second suture wanting; most of second, and all of following tergites polished; ovipositor sheaths about as long as the body.

Head yellowish ferruginous; antennae including scape piceous; palpi blackish; thorax ferruginous, propodeum brownish black; legs

ferruginous, the posterior coxae apically, the posterior femora, and all tibiae and tarsi, piceous to blackish; abdomen entirely black, including the sternites; wings clear hyaline, stigma dark brown, veins paler.

Type.—U.S.N.M. No. 43495.

Type locality.—San Diego, Calif.

Remarks.—Described from a single female specimen.

29. *MACROCENTRUS AFFINIS*, new species

Very similar to *seminiger*, but differing in the mostly brownish abdomen and yellowish legs, and in the longer palpi.

Female.—Length 5.5 mm. Face smooth, weakly punctate medially; eyes large, very prominent; clypeus rather large, strongly convex, subtruncate apically; distance from clypeal foveae to eyes less than length of clypeus; frons short, maxillary palpi much longer than width of head, the longest segment fully as long as second segment of antennal flagellum; apical segment of labial palpus much longer than the third; antennae a little longer than the body, 44-segmented. Thorax rather narrow, deep; prescutum prominently elevated; notauli not foveolate; scutellum more than half as long as propodeum; propodeum transversely striate, more weakly so basally, smooth at extreme base; prosternum smooth; sides of pronotum only indistinctly punctate; mesopleura flat, not depressed below, uniformly punctate, the punctures well separated; metapleura punctate; hind coxae polished; apical teeth of trochanters well developed; longer calcarium of hind tibia very nearly half as long as basitarsus; radius arising from a little beyond middle of stigma; radial cell ending much before wing apex; metacarpus extending the length of second intercubitus beyond apex of radial cell; first cubital cell about as long as first discoidal; second abscissa of cubitus much more than half as long as recurrent; nervulus postfurcal by half its length; submedian cell almost entirely glabrous, with only a few scattered hairs; mediella more than twice the length of lower abscissa of basella, the latter not quite as long as nervellus; upper abscissa of basella interstitial with transverse abscissa of subcostella; radiellian cell narrowing slightly at apex. Abdomen not distinctly longer than head and thorax; first tergite about twice as long as broad, deeply impressed at base, finely but not closely aciculate; second tergite not distinctly longer than broad at apex, smooth except toward base, where it is very feebly aciculate; remainder of dorsum of abdomen polished; ovipositor sheaths a little longer than the body.

Head yellowish ferruginous, vertex blackish; antennae including scape and pedicel blackish; palpi slightly dusky; thorax brownish varied with black in the depression surrounding scutellum, and on

propodeum; legs entirely yellow; wings clear hyaline; stigma dark brown, veins somewhat paler; abdomen brownish yellow, more or less blackish apically.

Type.—U.S.N.M. No. 43496.

Type locality.—Ithaca, N. Y.

Remarks.—Described from a single female specimen.

30. *MACROCENTRUS FUSCIPENNIS*, new species

Resembles *pallisteri*, but differs particularly in the unusually small nonprominent eyes, the broader face, the shorter robust abdomen, the relatively shorter second abdominal tergite, and the infumated wings.

Female.—Length 5 mm. Head rather thin antero-posteriorly; eyes unusually small, hardly half the height of head, and scarcely extending beyond outer margins of temples; face fully twice as broad as long, polished; malar space as long as clypeus; clypeus strongly convex, the distance between clypeal foveae hardly equal to distance from foveae to eyes; mandibles large; vertex convex, rising considerably above upper level of eyes; ocell-ocular and post-ocellar lines subequal, about twice the diameter of a lateral ocellus; maxillary palpi slightly longer than width of head, the longest segment not distinctly as long as second segment of antennal flagellum; antennae slightly longer than the body, 45-segmented.

Thorax rather stout; prescutum prominent, rather abruptly declivous in front; scutellar furrow not large; scutellum more than half the length of propodeum; propodeum broad, delicately rugulose, with some irregular, transverse raised lines on posterior half, the lateral carinae complete, strong; sides of pronotum, and the mesopleura and metapleura, smooth; prepectal carina complete; mesosternal furrow not deeply impressed posteriorly; posterior coxae faintly transversely lineolate above toward apex; longer calcarium of posterior tibia about half as long as metatarsus; apical teeth of trochanters well developed; radius arising from beyond middle of stigma; radial cell not nearly attaining extreme apex of wing; first cubital cell about as long as first discoidal; second abscissa of cubitus much more than half the length of recurrent vein; nervulus interstitial with basal vein; submedian cell weakly hairy at apex; radiella weakly sinuate, radiellian cell a little the narrowest at the middle; mediella fully twice lower abscissa of basella; nervellus not inclivous; upper abscissa of basella interstitial with transverse abscissa of subcostella.

Abdomen not distinctly longer than head and thorax combined, its greatest width about equal to width of mesoscutum; first tergite not twice as long as broad at apex, deeply impressed at base, entirely

closely striate, the spiracles not beyond basal fourth of tergite; second tergite broader at apex than long, longitudinally striate, the lateral depressed margins broad at base; third tergite subequal with second, finely aciculate at base; rest smooth, ovipositor sheaths about as long as the body.

Testaceous; palpi brownish; antennae piceous, scape and pedicel brownish yellow; legs deep testaceous; tarsi a little infuscated; wings distinctly somewhat fuscous.

Type.—U.S.N.M. No. 43497.

Type locality.—Germantown, Pa.

Remarks.—Described from three females from the type locality and one female from Maspeth, Long Island, N. Y. The type and one paratype were collected September 25, 1904, the two remaining paratypes on October 1, 1904, and September 27, 1924, respectively. The only paratype with complete antennae has these 45-segmented, like the type.

31. MACROCENTRUS PALLISTERI De Gant

Macrocentrus paediscæ RILEY MS., Insect Life, vol. 3, p. 59, 1891.

Macrocentrus pallisteri DE GANT, Proc. Ent. Soc. Washington, vol. 32, p. 65, 1930.

Type.—In the United States National Museum.

Closely related to *cerasivoranae*, and unusually pale specimens of *pallisteri* are sometimes difficult to distinguish from that species; however, the differences noted in the key will apparently separate the two. It is possible that *pallisteri* is identical with *pectoralis* Provancher, but I have not seen the type or authentically identified specimens of the latter, and accordingly am recognizing *pallisteri* as a valid name.

In length, specimens of *pallisteri* range from 5 mm. to 9 mm. Head but very slightly wider than thorax; face nearly twice as broad as long; temples and cheeks rounded, not strongly receding; clypeus large, long, subtruncate apically; longest segment of maxillary palpus not distinctly as long as second segment of antennal flagellum; antennae usually from 44 to 50 segmented.

Thorax stout; mesopleura anteriorly below, and prepectus, usually closely punctate, sometimes confluent so; mesosternal suture deeply impressed posteriorly; posterior coxae usually transversely aciculate or lineolate apically; first cubital cell large, about as long as first discoidal; second abscissa of cubitus much more than half as long as recurrent, often nearly as long; radius arising from beyond middle of stigma; submedian cell sparsely hairy, at least at apex; nervulus usually interstitial; hind wing with nervellus not inclivous, hardly as long as lower abscissa of basella, which is much less than half as

long as mediella; upper abscissa of basella interstitial with transverse abscissa of subcostella; radiella sinuate though less strongly than in *cerasivoranae*.

Abdomen usually rather stout; first and second tergites strongly longitudinally striate; the third sometimes more delicately so, and the sculpture restricted to basal half or two-thirds; first tergite impressed at base, the spiracles before end of basal fourth and farther from each other than from base of tergite; ovipositor sheaths fully as long as the body.

Ferruginous, varied with black; vertex and more or less of occiput usually blackish; face varying from entirely ferruginous or testaceous to black; thorax also varying from entirely testaceous to mostly black, usually at least the sutures of mesonotum, the metanotum, and the propodeum blackish; legs testaceous or ferruginous, tarsi usually more or less fuscous; wings subhyaline, stigma usually brown, pale at base; abdomen testaceous or ferruginous, the tergites beyond the third most frequently black.

In addition to the type the national collection has specimens representing a range in distribution from Massachusetts and eastern Canada to Missouri and Kansas. Hosts recorded are *Epiblema otiosana* Clemens, *E. scudderiana* Clemens, and *E. strenuana* Walker. I have also seen two collected specimens from Massachusetts in the collection of the Boston Society of Natural History, and one from New York in the Philadelphia Academy of Natural Sciences.

32. MACROCENTRUS CERASIVORANAE Viereck

Macrocentrus cerasivoranae VIERECK, Proc. U. S. Nat. Mus., vol. 42, p. 623, 1912.

Type.—In the United States National Museum.

Easily distinguished except from occasional specimens of *pallisteri*, and the longer antennae and palpi, the color characters mentioned in the key, the usually more strongly receding temples and cheeks, and the usually relatively shorter ocell-ocular line, will separate it from that species.

Length usually 7 to 9 mm. Head but little wider than thorax; face shining, but usually punctate; clypeus large, long, not distinctly twice as broad as long; eyes prominent, large; ocell-ocular line usually distinctly less than one and one-half times diameter of a lateral ocellus. Prescutum usually more prominently elevated than in *pallisteri*; lower part of mesopleura depressed and closely punctate; metapleura punctate, confluent so posteriorly; posterior coxae usually finely transversely aciculate or lineolate; first cubital cell about as long as first discoidal; second abscissa of cubitus distinctly more, usually much more, than half as long as recurrent vein; radius

arising from much beyond middle of stigma, inner side of latter twice as long as the outer; nervulus usually a little postfurcal, rarely interstitial; radiella strongly arched so that radiellan cell is very narrow at the middle; mediella twice as long as lower abscissa of basella, the latter fully as long as nervellus; upper abscissa of basella interstitial with transverse abscissa of subcostella. Abdomen longer than head and thorax combined; first and second, and most of third, tergites closely longitudinally striate; first tergite impressed at base; spiracles not beyond basal fourth of tergite; ovipositor sheaths a little longer than the body.

Color uniformly ferruginous; antennae sometimes more or less brownish; tarsi usually paler than femora or tibiae; wings hyaline; stigma uniformly yellow or brownish yellow.

In addition to the type series the national collection contains several specimens reared from *Cacoecia fervidana* Clemens in North Carolina and Virginia (C. Heinrich), two from *Cacoecia cerasivorana* Fitch in Ohio (H. C. Ingerson), and collected specimens from Maine, New Hampshire, New York, Pennsylvania, Connecticut, Michigan, Kansas, Colorado, Arizona, New Mexico, and Washington. Additional material examined consists of several specimens in the collection of the Boston Society of Natural History from Marthas Vineyard and Nantucket, Mass., and more than 200 specimens at the gipsy moth laboratory, which were reared from *C. cerasivorana* and *C. fervidana* taken at various localities in the New England States and New Jersey.

33. MACROCENTRUS DELICATUS Cresson

Macrocentrus delicatus CRESSON, Trans. Amer. Ent. Soc., vol. 4, p. 178, 1872.

Type.—In the Academy of Natural Sciences of Philadelphia.

Most closely allied to *nuperus* and *tewanus* but easily distinguished from both by lacking the conspicuous blackish transverse band on vertex, and otherwise as noted in the key.

One of the most common of the Nearctic species of *Macrocentrus*, and rather easily recognized. The following descriptive notes are given to supplement the characters mentioned in the key: Ranges in length from about 4 mm to about 8 mm. Head considerably wider than thorax; eyes very large; temples and cheeks strongly receding directly behind eyes; antennae usually 48 to 55 segmented, but rarely, in unusually large specimens, up to 60-segmented; the male scape conspicuously thickened; face smooth, not or indistinctly broader than long; longest segment of maxillary palpus usually a little longer than second segment of antennal flagellum. Mesoscutum smooth medially behind, the notauli usually not nearly extending

to apex; propodeum mostly delicately and more or less transversely sculptured, smooth at base; sides of pronotum and pleura polished; radius arising from much beyond middle of stigma, the first abscissa of radius perpendicular to anterior margin of wing, or only very slightly oblique; first discoidal cell longer than first cubital; submedian cell weakly hairy, usually with a hairless area apically; nervulus usually postfurcal by its own length, or very nearly; medially fully twice the lower abscissa of basella, the latter usually a little longer than nervellus. Abdomen with first, second, and more or less of third, tergites closely longitudinally aciculate; the first convex at base, not impressed in front of the spiracles, the latter near end of basal third and usually distinctly farther from base of tergite than from each other; spiracles not very prominent; ovipositor sheaths distinctly a little longer than the body.

Yellow; sometimes completely yellow, but most frequently with more or less of dorsum of thorax and abdomen varied with black; in the darkest specimens mesonotal lobes, scutellum, metanotum, and propodeum piceous to blackish with the abdomen entirely blackish except at apex; head always yellow; palpi pale yellow, antennae yellowish, basal flagellar segments sometimes darker; legs yellow; wings hyaline, stigma always entirely yellow, veins yellowish to brown.

The following material, in addition to the type, has been examined: At the United States National Museum, two paratypes from Texas and a large number of specimens from numerous localities ranging from Pennsylvania to Florida and Texas, and including material reared from *Laspeyresia molesta* Busck, *Pyrausta nubilalis* Hübner, *Rhopobota vacciniana* Packard, *Carpocapsa pomonella* Linnaeus, *Epiblema tripartitana* Zeller, *E. strenuana* Walker, *Aristotelia absconditella* Walker, *Euzophera ostricolorella* Hulst, *Proteopteryx bolliana* Slingerland, and *Tetralopha subcanalis* Walker; many specimens reared from *Laspeyresia molesta* and *Epiblema strenuana* taken in New Jersey, Tennessee, and Ohio, which were sent me for study by H. W. Allen, in charge of the oriental fruit moth investigations, at Moorestown, N. J.; a series from the European Corn Borer Laboratory, at Monroe, Mich., reared from *Papaipema nebris* Guenée, taken in Ohio; several hundred specimens reared by H. G. Butler, of the Bureau of Entomology, from *L. molesta* at Harrison, Tenn.; a series from the same host reared by J. O. Pepper at Chambersburg, Pa.; one specimen from Cohasset, Mass., in the collection of the Boston Society of Natural History, and 14 specimens at the gipsy moth laboratory reared from *Episimus argutatus* Clemens, taken at Revere and Roxbury, Mass.

34. *MACROCENTRUS NUPERUS* Cresson

Macrocentrus nuperus CRESSON, Trans. Amer. Ent. Soc., vol. 4, p. 178, 1872.

Type.—In the Academy of Natural Sciences of Philadelphia.

From *delicatus*, to which it is allied, *nuperus* differs especially in the longer and narrower three basal abdominal tergites, with the spiracles of the first even farther from the base and more prominent, in the nervulus being postfurcal by only half its length or less, in the somewhat longer malar space, and in having a transverse black band across vertex. From *texanus*, which it also closely resembles, it is readily distinguished by the much longer and strongly sculptured basal tergites of the abdomen and the shorter calcaria of the posterior tibiae.

In length the specimens examined range from 7 to 9 mm. Antennae usually more than 50-segmented; longest segment of maxillary palpus about as long as second segment of antennal flagellum; notauli extending nearly to extreme apex of mesoscutum; scutellar furrow very large; mesopleura usually punctate below; metapleural tooth prominent, truncate; posterior coxae very long; longer calcarium of hind tibia about half as long as metatarsus, not distinctly longer; radius arising from beyond middle of stigma; first discoidal cell somewhat longer than first cubital; submedian cell with only a few scattered hairs; mediella a little more than twice as long as lower abscissa of basella, the latter fully as long as nervellus; upper abscissa of basella interstitial with transverse abscissa of subcostella; abdomen much longer than head and thorax combined; first tergite more than three times as long as broad at apex, not at all impressed at base in front of spiracles, the surface of tergite irregularly longitudinally rugulose or ruguloso-striate, the spiracles at about end of basal third and much farther from base of tergite than from each other; second tergite twice as long as broad, longitudinally ruguloso-striate, parallel-sided, the lateral depressed margins rather broad, the raised sculptured part constricted medially; third tergite fully one and one-half times as long as broad, delicately longitudinally aciculated on basal half or more; ovipositor sheaths about as long as body.

Yellow; vertex with a transverse blackish band extending almost to the eyes; antennae yellow, the three or four basal flagellar segments blackish; mesonotal lobes with more or less dusky to blackish median markings, that on middle lobe usually broadest and darkest; wings hyaline, stigma yellow; legs yellow.

The foregoing notes are based on the type and on six collected specimens in the United States National Museum; four of these six are, like the type, from Texas; two are from Plummers Island, Md.

35. MACROCENTRUS TEXANUS, new species

Most similar to *nuperus* and *delicatus* but distinguished as noted in the key and in the discussions under those species. It is also closely allied to *uniformis*, which it resembles in the long calcaria of the posterior tibiae, the prominent acute metapleural tooth, the unusually long second abscissa of cubitus, the unusually long palpi, the sinuate radiella, and the mostly smooth abdomen; but it differs especially in the long ovipositor, the less strongly compressed abdomen, the shape of the first abdominal tergite, which narrows rather strongly from the spiracles to the base, and the narrow temples and cheeks.

Female.—Length 8 mm. Head strongly transverse; temples and cheeks receding directly behind the eyes; eyes large, very prominent; malar space short; face broader than long, polished; vertex rising scarcely above upper level of eyes; postocellar and ocell-ocular lines subequal, about one and one-half times the diameter of a lateral ocellus; maxillary palpi very long, the longest segment nearly as long as first segment of antennal flagellum, much longer than second; apical segment of labial palpus long; antennae much longer than body, 56-segmented; scape rather stout.

Thorax short; notauli not foveolate except posteriorly; propodeum short, not convex longitudinally, very weakly transversely sculptured, nearly smooth at base; sides of pronotum, and the mesopleura and metapleura, smooth; mesosternal suture distinct only posteriorly; legs long, slender; longer calcarium of hind tibia longer than half the basitarsus; stigma elongate, radius arising from a little beyond its middle; second abscissa of cubitus longer than recurrent; first cubital cell fully as long as first discoidal; third abscissa of radius less than twice the second; nervulus postfurcal by at least two-thirds its length; submedian cell hairless; first brachial cell with only scattered hairs; radiella somewhat sinuate, the radiellian cell broadest at apex, narrowest at middle; mediella hardly twice the lower abscissa of basella, the latter a little longer than nervellus.

Abdomen slender, longer than head and thorax combined; first tergite nearly three times as long as broad at apex, not at all impressed at base in front of spiracles, mostly smooth, with only a little indefinite sculpture near middle, the spiracles near end of basal third, and much farther from base of tergite than from each other; second and third tergites subequal, the second not distinctly longer than third, both slightly longer than wide, both with a little faint aciculation at base; ovipositor sheaths fully as long as the body.

Testaceous; vertex with a transverse blackish band extending very nearly to the eyes; mesonotal lobes blackish medially; wings hyaline,

costa and stigma yellow; antennae yellow, the basal flagellar segments not darker.

Type.—U.S.N.M. No. 43493.

Type locality.—Dallas, Tex.

Remarks.—Described from a single specimen collected April 17, 1908, by F. C. Bishopp.

36. *MACROCENTRUS UNIFORMIS* Provancher

Macrocentrus uniformis (CRESSON) PROVANCHER, Nat. Can., vol. 12, p. 173, 1880.

Type.—In the Museum of Public Instruction, Quebec, Canada.

Differs from all other Nearctic species in its very short ovipositor, which is shorter than the height of the apical truncature of the abdomen. It agrees in this as well as in all other important respects with the genotypes of *Dolichozele* Viereck and *Paniscozele* Enderlein, the synonymy of which has been discussed earlier in this paper. Except for the decided difference in the ovipositor it rather closely resembles *texanus*, being readily separable, however, by the differences mentioned in the key and in the description of that species.

A large species, ranging in length from about 7 to 10 mm. Head transverse, wider than thorax; temples and cheeks convex, not receding directly behind eyes; eyes prominent, diverging a little below; face at least one and one-half times as broad as long; malar space as long as basal width of mandible; mandibles stout; maxillary palpi very long, the longest segment longer than first segment of antennal flagellum; labial palpi much longer than face; antennae more than one and one-half times as long as the body, about 50-segmented.

Thorax rather short, deep, mostly smooth and shining; prescutum prominent; propodeum more or less transversely rugulose, smooth basally at least at sides; pleura smooth; metapleural tooth prominent, acute; legs very slender; posterior coxae long; longer calcarium of hind tibia much more than half as long as basitarsus in the male, in the female usually three-fourths as long, the basitarsus being relatively longer in the male than in the female; wings very large and broad; stigma elongate, radius arising from beyond its middle; radial cell very nearly attaining extreme apex of wing; first cubital cell large, very nearly or quite as long as first discoidal; second abscissa of cubitus more than half as long, sometimes as long, as recurrent vein; nervulus only slightly postfurcal; submedian cell widened at apex and entirely glabrous; first brachial cell also glabrous basally; mediella twice as long as lower abscissa of basella, which is longer than nervellus and about twice as long as upper abscissa of basella; radiella strongly sinuate, the radiellian cell very narrow at the middle.

Abdomen a little longer than head and thorax combined, compressed apically; first tergite slender, more than three times as long as broad at apex, not distinctly impressed at base in front of spiracles, the latter prominent, a little farther from base of tergite than from each other; second and third tergites not distinctly separated, the second suture wanting or very faint; dorsal surface of abdomen smooth, sometimes with a little faint sculpture on first tergite; ovipositor sheaths shorter than height of apical truncature of abdomen.

Testaceous or ferruginous; the head in front, pleura, and sternum usually paler; antennae usually testaceous, brownish apically, but sometimes flagellum entirely dark; vertex completely black; usually mesonotal lobes more or less blackish down the middle, wings hyaline, veins brown, stigma testaceous; legs testaceous, hind tarsi pale yellow.

The national collection contains 34 specimens; of these 4 were reared from *Psycomorpha epimenis* Drury at Green Village, N. J., by Charles Rummel; the remainder are collected specimens from various localities in Maryland, Virginia, Pennsylvania, District of Columbia, North Carolina, Kentucky, Georgia, Illinois, and Kansas. I have also examined 11 specimens taken at Raleigh, N. C., which were sent me by C. S. Brimley; a single specimen at the gipsy moth laboratory reared from *Alypia octomaculata* Fabricius by J. V. Schaffner, jr., the host having been taken at Brockport, N. Y.; and a specimen at the Academy of Natural Sciences of Philadelphia labeled "*Macrocentrus uniformis* Cress. MS."

SPECIES THAT HAVE NOT BEEN RECOGNIZED

MACROCENTRUS IRIDESCENS French

Macrocentrus iridescens FRENCH, 6th Ann. Rep. Southern Illinois Normal Univ., p. 42, 1880.

Type.—Location unknown.

It has not been possible to identify this species with certainty from the original description; accordingly it has been omitted from the key. However, I have seen two male specimens in the Academy of Natural Sciences of Philadelphia that are labeled "Carbondale, Ills., May 18, 1878, French Coll." and bear the name label *Macrocentrus iridescens* French. These are *amicroploides* Viereck. If they are correctly identified as *iridescens* it will become necessary to suppress *amicroploides* as a synonym. Since French, in his description, acknowledged his indebtedness to E. T. Cresson for the generic determination of the species, and since his type series consisted of 12 specimens, it seems rather likely that he sent Cresson specimens for the collection of the Philadelphia Academy, and that the two specimens referred to above are actually paratypes. Nevertheless, I hesitate to synonymize *amicroploides*, owing to the fact that French described the ovipositor of *iridescens* as "not exerted."

MACROCENTRUS NIGRIDORSIS Viereck

Macrocentrus nigridorsis VIERECK, Can. Ent., vol. 56, p. 68, 1924.

Type.—In the Canadian National Collection at Ottawa.

As already mentioned this species is obviously very similar to, if not identical with, *harrisi*; there appears to be nothing in the original description which will separate it from *harrisi*, and I believe a comparison of the types will make necessary the suppression of the latter name as a synonym.

MACROCENTRUS PECTORALIS Provancher

Macrocentrus pectoralis PROVANCHER, Nat. Can., vol. 12, p. 173, 1880.

Type.—In the Museum of Public Instruction at Quebec, Canada,

Since I have not seen the type, and am unable definitely to identify the species from the original description or from notes made by Rohwer, I have omitted *pectoralis* from the key. It appears, however, to be exceedingly similar to *pallisteri* and may be found to be identical with that species, in which case *pallisteri* would fall as a synonym.

HOSTS OF MACROCENTRUS RECORDED IN THIS PAPER

Host	Species of Macrocentrus
<i>Acrobasis caryivorella</i> Ragonot	<i>instabilis</i> Muesebeck
<i>hebescella</i> Hulst	<i>instabilis</i> Muesebeck
sp	<i>laspeyresiae</i> Muesebeck
<i>Alypia octomaculata</i> Fabricius	<i>uniformis</i> Provancher
<i>Anacampsis</i> sp	<i>ancylivorus</i> Rohwer
<i>Ancylis comptana</i> Frölich	<i>ancylivorus</i> Rohwer
sp	<i>nigripectus</i> Muesebeck
<i>Aristotelia absconditella</i> Walker	<i>delicatus</i> Cresson
<i>Cacoecia argyrospila</i> Walker	<i>microplodes</i> Viereck
<i>cerasivorana</i> Fitch	<i>cerasivoranae</i> Viereck
<i>fervidana</i> Clemens	<i>cerasivoranae</i> Viereck
<i>parallela</i> Robinson	<i>harrisi</i> De Gant
<i>purpurana</i> Clemens	<i>harrisi</i> De Gant
<i>rosaceana</i> Harris	<i>microplodes</i> Viereck
<i>rosana</i> Linnaeus	<i>microplodes</i> Viereck
<i>Canarsia</i> sp	<i>canarsiae</i> Muesebeck
<i>Canarsia</i> sp	<i>ancylivorus</i> Rohwer
<i>Carpocapsa pomonella</i> Linnaeus	<i>ancylivorus</i> Rohwer
	<i>laspeyresiae</i> Muesebeck
	<i>delicatus</i> Cresson
<i>Coloeophora malivorella</i> Riley	<i>instabilis</i> Muesebeck
<i>Crambus hortuellus</i> Hübner	<i>crambivorus</i> Viereck
<i>mutabilis</i> Clemens	<i>crambi</i> (Ashmead)
<i>trisectus</i> Walker	<i>crambi</i> (Ashmead)
<i>zeellus</i> Fernald	<i>crambi</i> (Ashmead)
sp	<i>crambivorus</i> Viereck
<i>Crocidophora pustuliferalis</i> Lederer	<i>crocidophorae</i> Muesebeck
<i>Epagoge</i> sp	<i>ancylivorus</i> Rohwer
<i>Epiblema otiosana</i> Clemens	<i>pallisteri</i> De Gant
<i>scudderiana</i> Clemens	<i>pallisteri</i> De Gant
<i>strenuana</i> Walker	<i>pallisteri</i> De Gant
	<i>delicatus</i> Cresson
	<i>ancylivorus</i> Rohwer
<i>tripartitana</i> Zeller	<i>delicatus</i> Cresson
<i>Epistmus argutatus</i> Clemens	<i>delicatus</i> Cresson
<i>Euzophora ostricolorella</i> Hulst	<i>delicatus</i> Cresson
<i>Euartema fasciatana</i> Clemens	<i>harrisi</i> De Gant
<i>sericorana</i> Walsingham	<i>ancylivorus</i> Rohwer
<i>Hadena devastatrix</i> Brace	<i>crassipes</i> Muesebeck
<i>Harpiteryx frustrella</i> Walsingham	<i>microplodes</i> Viereck
<i>Homosoma electellum</i> Hulst	<i>ancylivorus</i> Rohwer
<i>Laspeyresia caryana</i> Fitch	<i>laspeyresiae</i> Muesebeck
(?) <i>cupressana</i> Kearfott	<i>aegeriae</i> Rohwer
<i>funebrana</i> Treitschke	<i>instabilis</i> Muesebeck

Host	Species of <i>Macrocentrus</i>
<i>Laspeyresia molesta</i> Busck	<i>anolyvorus</i> Rohwer
	<i>instabilis</i> Muesebeck
	<i>delicatus</i> Cresson
	<i>laspeyresiae</i> Muesebeck
<i>Papaipema nebris</i> Guenée	<i>delicatus</i> Cresson
<i>Peronea variana</i> Fernald	<i>peroneae</i> Muesebeck
<i>Proteopteryx bolliana</i> Slingerland	<i>aegeriae</i> Rohwer
	<i>delicatus</i> Cresson
<i>Psycomorpha epimentis</i> Drury	<i>uniformis</i> Provancher
<i>Pyrausta ainsliei</i> Heinrich	<i>utilis</i> Muesebeck
<i>nubilalis</i> Hübner	<i>gifuensis</i> Ashmead
	<i>robustus</i> Muesebeck
	<i>delicatus</i> Cresson
<i>pertentalis</i> Lederer	<i>pyraustae</i> Viereck
	<i>amicroploides</i> Viereck
<i>theseusalis</i> Walker	<i>pyraustae</i> Viereck
<i>Rhopobota vacciniana</i> Packard	<i>delicatus</i> Cresson
<i>Rhyacionia rigidana</i> Fernald	<i>laspeyresiae</i> Muesebeck
<i>Synanthedon americana</i> Beutenmüller	<i>aegeriae</i> Rohwer
<i>castaneae</i> Busck	<i>aegeriae</i> Rohwer
<i>exitiosa</i> Say	<i>aegeriae</i> Rohwer
<i>pictipes</i> Grote and Robinson	<i>aegeriae</i> Rohwer
<i>tipuliformis</i> Linnaeus	<i>aegeriae</i> Rohwer
<i>Tetralopha subcanalis</i> Walker	<i>delicatus</i> Cresson
<i>Tmetocera ocellana</i> Schiffermüller	<i>amicroploides</i> Viereck

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